AD-A134788

INSTALLATION RESTORATION PROGRAM

PHASE I - RECORDS SEARCH

CASTLE AFB, CALIFORNIA

PREPARED FOR

UNITED STATES AIR FORCE
AFESC/DEV
Tyndall AFB, Florida

and

HQ SAC/DEPV
Offutt AFB, Nebraska

OCTOBER 1983

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PII Redacted

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The Phase I record search of the Strategic Air Command Installation Restoration Program constitutes an indepth records search to idemtify past hazardous disposal sites and determine the potential, if any, for migration of toxic substances off base. The final report indicates the Plase II - quantification effort should be accomplished.

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CASTLE AFB, CALIFORNIA

Prepared For

United States Air Force
AFESC/DEV
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Offutt AFB, Nebraska

October 1983

Prepared By

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EXECUTIVE SUMMARY

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous material disposal sites on DOD property, to control the migration of hazardous contaminants, and to control hazards to health or welfare that may result from these past disposal operations. This program is called the Installation Restoration Program (IRP). The IRP has four phases consisting of Phase I, Initial Assessment/Records Search; Phase II, Confirmation and Quantification; Phase III, Technology Base Development; and Phase IV, Operations/Remedial Actions. Engineering-Science (ES) was retained by the United States Air Force to conduct the Phase I, Initial Assessment/Records Search for Castle AFB with funds provided by the Strategic Air Command (SAC).

INSTALLATION DESCRIPTION

Castle AFB is located in the upper northwest half of Merced County, which is located in the geographic center of the State of California. The land on which the base is located is relatively flat, sloping from approximately a 195' elevation at the north boundary to about 165' elevation at the southwest boundary. The area surrounding Castle AFB is predominantly flat land with the exception of a hilly area to the northeast along the Merced River. The base is adjacent to the City of Atwater and approximately five miles northwest of the City of Merced.

Castle AFB presently contains 2,777 acres comprising runways and airfield operations, industrial areas, housing, recreational facilities and several non-contiguous parcels of land located in the immediate vicinity of the base. The non-continuous areas include two housing annexes south of the base totalling 206 acres, an ILS middle marker and outer marker located southeast of the base each of which are less than one acre.

Castle AFB was initially activated as an Army air base in the second half of 1941. The primary mission of the base during the early 1940's entailed aircrew training. In 1945, all flying personnel and

aircraft were transferred to another California air base. The Strategic Air Command (SAC) assumed responsibility of the base in 1946 when the 93rd Bombardment Group was assigned to Castle AFB. The 93rd received its first B-50 in June 1949. In 1954, B-47's were assigned to the Wing. In 1955, the B-52's first arrived at Castle AFB and shortly thereafter B-52 crews were being trained for SAC. The mission was again modified in May 1957 with the arrival of the KC-135 stratotanker and subsequent increase in the training program to include tanker crews.

ENVIRONMENTAL SETTING

The environmental setting data reviewed for this investigation indicate the following major points that are relevant to the evaluation of past hazardous waste management practices at Castle AFB:

- o The mean annual precipitation is 12.23 inches; the net precipitation is -41 inches and the one-year 24-hour rainfall event is 1.25 inches. These data indicate a net precipitation deficiency and very low potential for storms to create surface runoff. These factors are important in limiting natural surface-water infiltration which might promote leachate generation.
- o Man-made infiltration methods (agricultural irrigation) operating on and near the base increase the rate of infiltration thereby potentially increasing the rate of leachate generation from waste sites on the base.
- o Dewatering and irrigation wells used in conjunction with agricultural processes are operating near the base which may impact the ground-water gradients within the shallow unconfined aquifer on base.
- o The soils on base are typically sand, silty sand, and sandy silt and are generally well drained. A hardpan layer generally less than five feet below ground, is discontinuous over the base and may restrict the vertical movement of shallow ground water. Where vertical movement is restricted, the ground water forms perched water tables. The permanent water table is generally encountered at 30 feet below ground within sand and gravel zones comprising the shallow unconfined aquifer. These data indicate

a moderately deep permanent water table with highly permeable zones underlying the base, but a perched water table above discontinuous hardpan. These factors are important in the generation of leachate and in the determination of possible contaminant flowpaths away from a waste site.

- Clay zones as much as 100 feet thick beneath the unconfined shallow aquifer may restrict the vertical movement of ground water. This fact indicates that possible contaminant movement may be restricted to horizontal movements within the unconfined shallow aquifer. This aquifer is extensively used off base as a water supply source.
- The intermediate confined aquifer lies beneath the clay zone and is used as a water supply source for the base.
- The lower confined aquifer lies beneath additional clay zones and is a primary source of drinking water for users downgradient of the base.
- The base and vicinity are recharge zones for the unconfined shallow aquifer and potential recharge areas for the intermediate and lower confined aquifers. These data indicate a potential for downward movement of ground water and possible contaminants.
- The ground-water quality of the unconfined shallow aquifer and the intermediate confined aquifer have been impacted by TCE both on base and off base. These data document ground-water contamination, but the source(s) have not been identified.
- Examination of the surface water analytical data in the vicinity of the base indicates that no degradation of the water quality has occurred as a result of the surface runoff from the base.
- Analytical surface water data in the vicinity of the base indicates that no degradation of the water quality has occurred as a result of the surface runoff from the base.
- There are no threatened or endangered species on Castle AFB.

METHODOLOGY

During the course of this project, interviews were conducted with base personnel (past and present) familiar with past waste disposal practices; file searches were performed for past hazardous waste activities; interviews were held with local, state and Federal agencies; and field and helicopter reconnaissance inspections were conducted at past hazardous waste activity sites. Twenty-six sites were identified as potentially containing hazardous contaminants resulting from past activities (Figure 1). These sites have been assessed using a Hazard Assessment Rating Methodology (HARM) which takes into account factors such as site characteristics, waste characteristics, potential for contaminant migration and waste management practices. The details of the rating procedure are presented in Appendix G and the results of the assessment are given in Table 1. The rating system is designed to indicate the relative need for follow-on action.

FINDINGS AND CONCLUSIONS

The following conclusions have been developed based on the results of the project team's field inspection, review of base records and files, and interviews with base personnel.

The areas determined to have a high potential for environmental contamination are as follows:

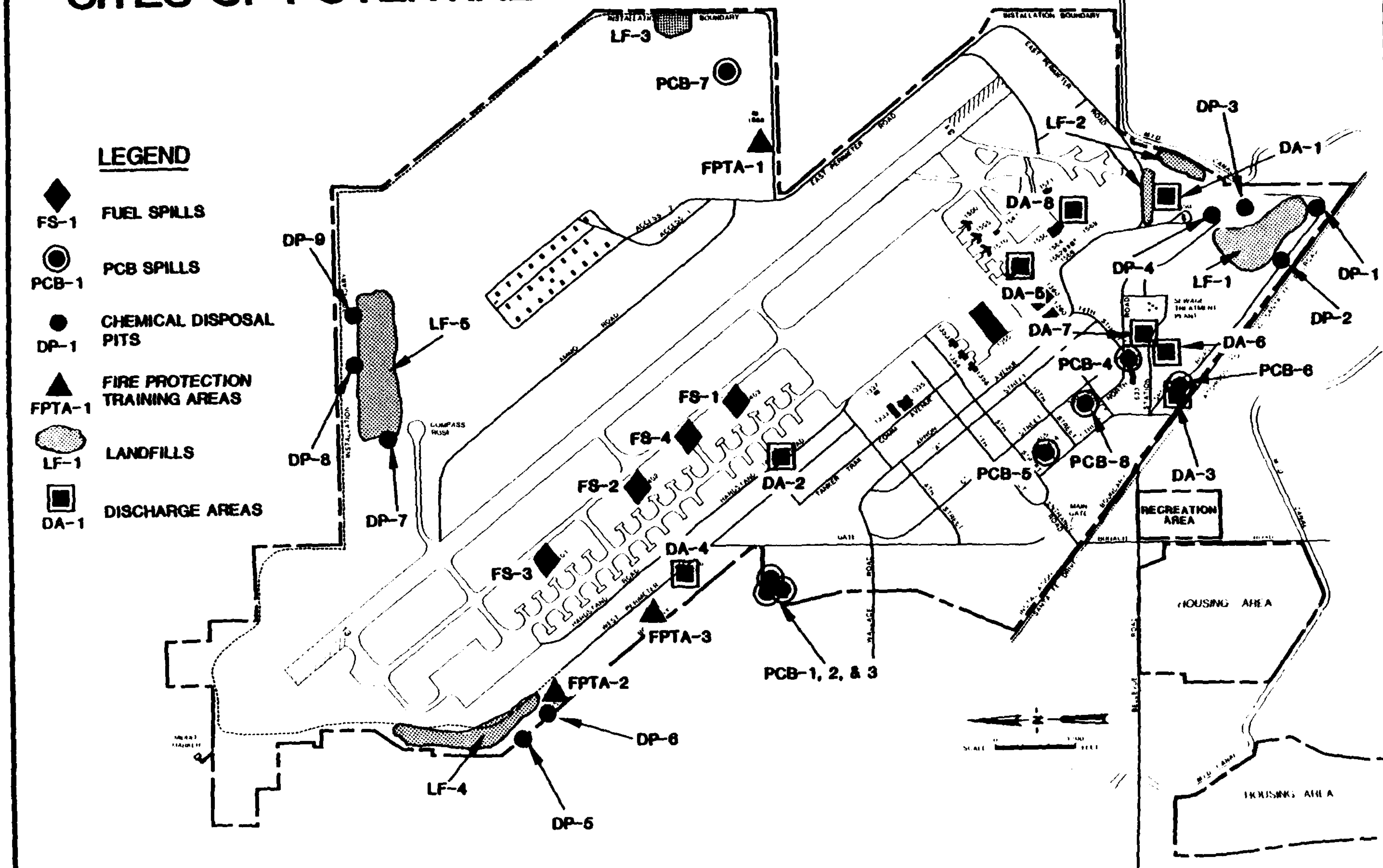
- Landfill No. 1
  Chemical Disposal Pits Nos. 1, 2, and 3
- Fire Protection Training Area No. 1
- Landfill No. 5
  Chemical Disposal Pits Nos. 7, 8, and 9
- Discharge Area No. 1
- Discharge Area No. 8
  Note: Concentrations of TCE have been detected in the ground water in close proximity to this site. It is suspected that the TCE is linked to the disposal practices which occurred at this site and hence should be evaluated in conjunction with any further studies of this disposal site.

TABLE 1
PRIORITY RANKING OF POTENTIAL CONTAMINATION SOURCES

Rank	Site Name	Date of Operation or Occurrence	Overall Total Score
1	Landfill No. 1 Chemical Disposal Pits Nos. 1,2,and 3	1940-1950	82
2	Fire Protection Training Area No. 1	1955-1975	76
2	Landfill No. 5 Chemical Disposal Pits Nos. 7,8,and 9	1971-1977	76
4	Discharge Area No. 1	1950's-1983	72
5	D_scharge Area No. 8	Pre 1973-1976	71
6	Fuel Spill No. 1	1977	68
7	Discharge Area No. 4	1950-1980	66
7	Discharge Area No. 7	Prior to 1979	66
7	Landfill No. 4 Chemical Disposal Pit Nos. 5 and 6	1957-1970	66
10	Chemical Disposal Pit No. 4	1950's	64
10	Discharge Area No. 2	1970's-1983	64
10	Discharge Area No. 3	1950-1983	64
10	Discharge Area No. 5	1950's-1982	64
10	Fuel Spill No. 4	Early 1960's	64
15	PCB Spill Nos. 1,2,3	1980-1983	62
16	Discharge Area No. 6	1960's-1977	59
17	Fire Protection Training Area No. 3	1976-present	54
18	Fuel Spill Nos. 2 and 3	1950's-1977	50
18	Landfill No. 2	1951-1953	50
18	Fire Protection Training Area No. 2	1962-1967	50
21	Landfill No. 3	1954-1956	48
22	PCB Spill No. 6	1982	7
22	PCB Spill No. 4	1970-1980	7
24	PCB Spill No. 8	1982	6
24	PCB Spill No. 5	1979-1982	6
26	PCB Spill No. 7	1980	5

FIGURE 1

CASTLE AFB
SITES OF POTENTIAL ENVIRONMENTAL CONTAMINATION



NOTE: LOCATIONS OF CHEMICAL PITS HAVE BEEN APPROXIMATED

SOURCE: CASTLE AFB INSTALLATION DOCUMENTS

- o Fuel Spill No. 1

The areas determined to have a moderate potential for environmental contamination are as follows:

- o Discharge Area No. 4
- o Discharge Area No. 7
- o Landfill No. 4
  Chemical Disposal Pit Nos. 5 and 6
- o Chemical Disposal Pit No. 4
- o Discharge Area No. 2
- o Discharge Area No. 3
- o Discharge Area No. 5
- o Fuel Spill No. 4
- o PCB Spill Nos. 1, 2, and 3

The areas determined to have a low potential for enviromental contamination are as follows:

- o Discharge Area No. 6
- o Fire Protection Training Area No. 2
- o Fire Protection Training Area No. 3
- o Landfill No. 2
- o Landfill No. 3
- o Fuel Spill No. 2 and 3
- o PCB Spill No. 4
- o PCB Spill No. 5
- o PCB Spill No. 6
- o PCB Spill No. 7
- o PCB Spill No. 8

RECOMMENDATIONS

Recommended guidelines for future land use restrictions at the twenty-six sites identified in Table 1 are presented in Section 6. The

detailed recommendations developed for further assessment of environmental areas of concern at Castle AFB are also presented in Chapter 6. These recommendations are summarized as follows:

TCE Contaminant Plume	Two phase investigation to determine pathway of TCE migration from shallow unconfined aquifer to the drinking water wells. The investigation should entail the following tasks: <u>Phase A</u> o Confirm well construction of base water supply wells with downhole color TV camera. Locate any casing cracks. o Conduct downhole geophysical survey including fluid, conductivity log, differential temperature log, flowmeter log and caliper log. o Seal any identified cracks by pressurized grouting. <u>Phase B</u> Conduct Phase B if Phase A reveals no casing cracks exist. o Conduct natural gamma ray log, density log and neutron log of base drinking water wells. o Conduct interaquifer pump test to determine if permeable zones between the aquifers are allowing contamination to migrate.
Discharge Area No. 8	Conduct geophysical survey of area. Install shallow wells to determine the presence of TCE contamination in the general area. The number of monitoring wells will depend upon the results of the TCE contaminant plume investigation. Collect three sediment samples in the ditch south of Building 1550 and analyze for TCE.
Landfill No. 1 Chemical Disposal Pit Nos. 1, 2, 3 and 4	Conduct geophysical survey of area. Install three upgradient wells, four downgradient wells and two lysimeters.
Discharge Area No. 1	Wells and lysimeters should be sampled for parameters in Table 6.2, List A.

Fire Protection Training Area No. 1	Conduct geophysical survey of area. Install one upgradient and two downgradient wells, and two downgradient lysimeters. Water samples should be analyzed for parameters in Table 6.2, List B.
Landfill No. 5 Chemical Disposal Pit Nos. 7, 8 and 9	Conduct geophysical survey of area. Install one upgradient and four downgradient wells, and two downgradient lysimeters. Water samples should be analyzed for parameters in Table 6.2, List A.
Landfill No. 4 Chemical Disposal Pit Nos. 5 and 6	Conduct geophysical survey of area. Install one upgradient and four downgradient wells. Well samples should be analyzed for parameters in Table 6.2, List A.
PCB Spill Nos. 1, 2, 3,	Collect three soil samples in area where spills occurred to confirm contaminated materials have been removed.
Fuel Spills Nos. 1, 2, 3 and 4	Install four shallow wells, downgradient from the general area of the fuel spills. Two wells should penetrate any hardpan found in the area and the remaining two wells should extend to the upper surface of the hardpan. The wells should be analyzed for TOC, oil and grease, total organic halogen and benzene.
Discharge Areas	
Discharge Area No. 2	Remove visually contaminated soils. Modify disposal procedures to eliminate overland discharge.
Discharge Area No. 3	Collect two soil samples from drainage ditch behind discharge area and analyze for parameters in Table 6.2, List A.
Discharge Area No. 4	Collect two surface soil samples and analyze for TCE.

Discharge Area No. 5	Collect three sediment samples from the drainage ditch receiving the release from this discharge area. The samples should be analyzed for the parameters in Table 6.2, List A.
Discharge Area No. 7	Collect two surface soil samples in area and conduct a chlorinated hydrocarbon and organo-phosphate pesticide scan on these samples.

SECTION 1

INTRODUCTION

BACKGROUND

The United States Air Force, due to its primary mission, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations and contents of disposal sites and take action to eliminate the hazards in an environmentally responsible manner. The primary Federal legislation governing disposal of hazardous waste is the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. Under Section 6003 of the Act, Federal agencies are directed to assist the Environmental Protection Agency (EPA) and under Section 3012 state agencies are required to inventory past disposal sites and make the information available to the requesting agencies. To assure compliance with these hazardous waste regulations, Department of Defense (DOD) developed the Installation Restoration Program (IRP). The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated 11 December 1981 and implemented by Air Force message dated 21 January 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the Installation Restoration Program. DOD policy is to identify and fully evaluate suspected problems associated with past hazardous contamination, and to control hazards to health and welfare that resulted from these past operations. The IRP will be the basis for response actions on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as clarified by Executive Order 12316.

PURPOSE AND SCOPE OF THE ASSESSMENT

The Installation Restoration Program has been developed as a four-phased program as follows:

Phase I - Initial Assessment/Records Search
Phase II - Confirmation and Quantification
Phase III - Technology Base Development
Phase IV - Operations/Remedial Actions

Engineering-Science (ES) has been retained by the United States Air Force to conduct the Phase I Records Search at Castle Air Force Base with funds provided by the Strategic Air Command. This report contains a summary and an evaluation of the information collected during Phase I of the IRP and recommendations for follow-on actions.

The goal of the first phase of the program was to identify the potential for environmental contamination from past waste disposal practices at Castle AFB, and to assess the potential for contaminant migration. The activities that were performed in the Phase I study included the following:

- Review of site records
- Interviews with personnel familiar with past generation and disposal activities
- Inventory of wastes
- Determination of estimated quantities and locations of current and past hazardous waste treatment, storage, and disposal
- Definition of the environmental setting at the base
- Review of past disposal practices and methods
- Conduct field and aerial inspections
- Gather pertinent information from Federal, state and local agencies
- Assess potential for contaminant migration
- Develop conclusion and recommendations for follow-on action

ES performed the on-site portion of the records search during July 1983. The following team of professionals was involved:

- C. M. Mangan, Environmental Engineer and Project Manager, MSCE, 15 years professional experience.
- M. I. Spiegel, Environmental Scientist, BS Environmental Science, 6 years of professional experience.
- Y. Nordhav, Geologist, M. S. Geology, 6 years of professional experience.
- D. Duprey, Environmental Engineer, BSCE, 2 years professional experience.

More detailed information on these individuals is presented in Appendix A.

METHODOLOGY

The methodology utilized in the Castle AFB Records Search began with a review of past and present industrial operations conducted at the base. Information was obtained from available records such as shop files and real property files, as well as interviews with past and present base employees from the various operating areas. Those interviewed included current and past personnel associated with the Civil Engineering Squadron, Bioenvironmental Engineering Services, Equipment Maintenance Squadron, Field Maintenance Squadron, Munition Maintenance Squadron, Fuels Management Branch and tenant organizations on the base. A listing of Air Force interviewees by position and approximate period of service is presented in Appendix B.

Concurrent with the base interviews, the applicable Federal, state and local agencies were contacted for pertinent base related environmental data. The ten agencies contacted and interviewed are listed in Appendix B.

The next step in the activity review was to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the various operations on the base. Included in this part of the activities review was the identification of all

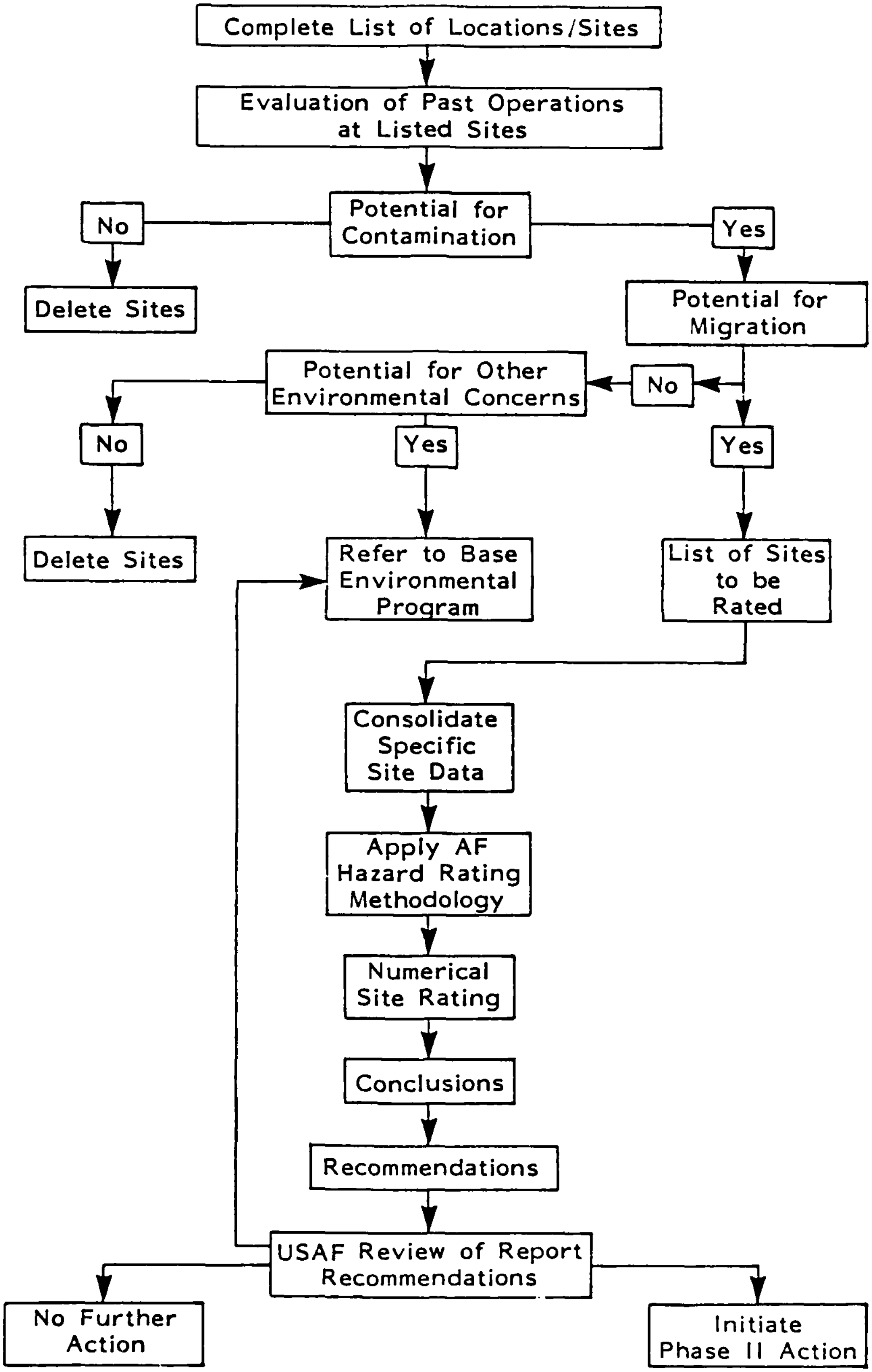
known past disposal sites and other possible sources of contamination such as spill areas.

A general ground tour and a helicopter overflight of the identified sites were then made by the ES Project Team to gather site-specific information including: (1) visual evidence of environmental stress; (2) the presence of nearby drainage ditches or surface water bodies; and (3) visual inspection of these water bodies for any obvious signs of contamination or leachate migration.

A decision was then made, based on all of the above information, whether a potential exists for hazardous material contamination at any of the identified sites using the Decision Tree shown in Figure 1.1. If no potential existed, the site was deleted from further consideration. For those sites where a potential for contamination was identified, a determination of the potential for migration of the contamination was made by considering site-specific conditions. If there were no further environmental concerns, then the site was deleted. If the potential for contaminant migration was considered significant, then the site was evaluated and prioritized using the Hazard Assessment Rating Methodology (HARM). A discussion of the HARM system is presented in Appendix G. The sites, which were evaluated using the HARM procedures, were also reviewed with regard to future land use restrictions.

PHASE I INSTALLATION RESTORATION PROGRAM

DECISION TREE



SECTION 2

INSTALLATION DESCRIPTION

LOCATION, SIZE AND BOUNDARIES

Castle AFB is located in the upper northwest half of Merced County, which is in the geographic center of the State of California (Figures 2.1 and 2.2). The county spans the San Joaquin Valley from the crest of the Diablo Mountains on the west to the foothills of the Sierra Nevada Mountain Range on the east. The land on which the base is located is relatively flat, sloping from approximately a 195' elevation at the north boundary to about 165' elevation at the southwest boundary. The area surrounding Castle AFB is predominantly flat land with the exception of a hilly area to the northeast along the Merced River. The base is adjacent to the City of Atwater and approximately five miles northwest of the City of Merced.

Castle AFB presently contains 2,777 acres comprised of runways and airfield operations, industrial areas, housing, recreational facilities and several non-contiguous parcels of land located in the immediate vicinity of the base (Figure 2.3). The non-continguous areas include two housing annexes south of the base totaling 206 acres, an ILS middle marker and outer marker located southeast of the base each of which are less than one acre.

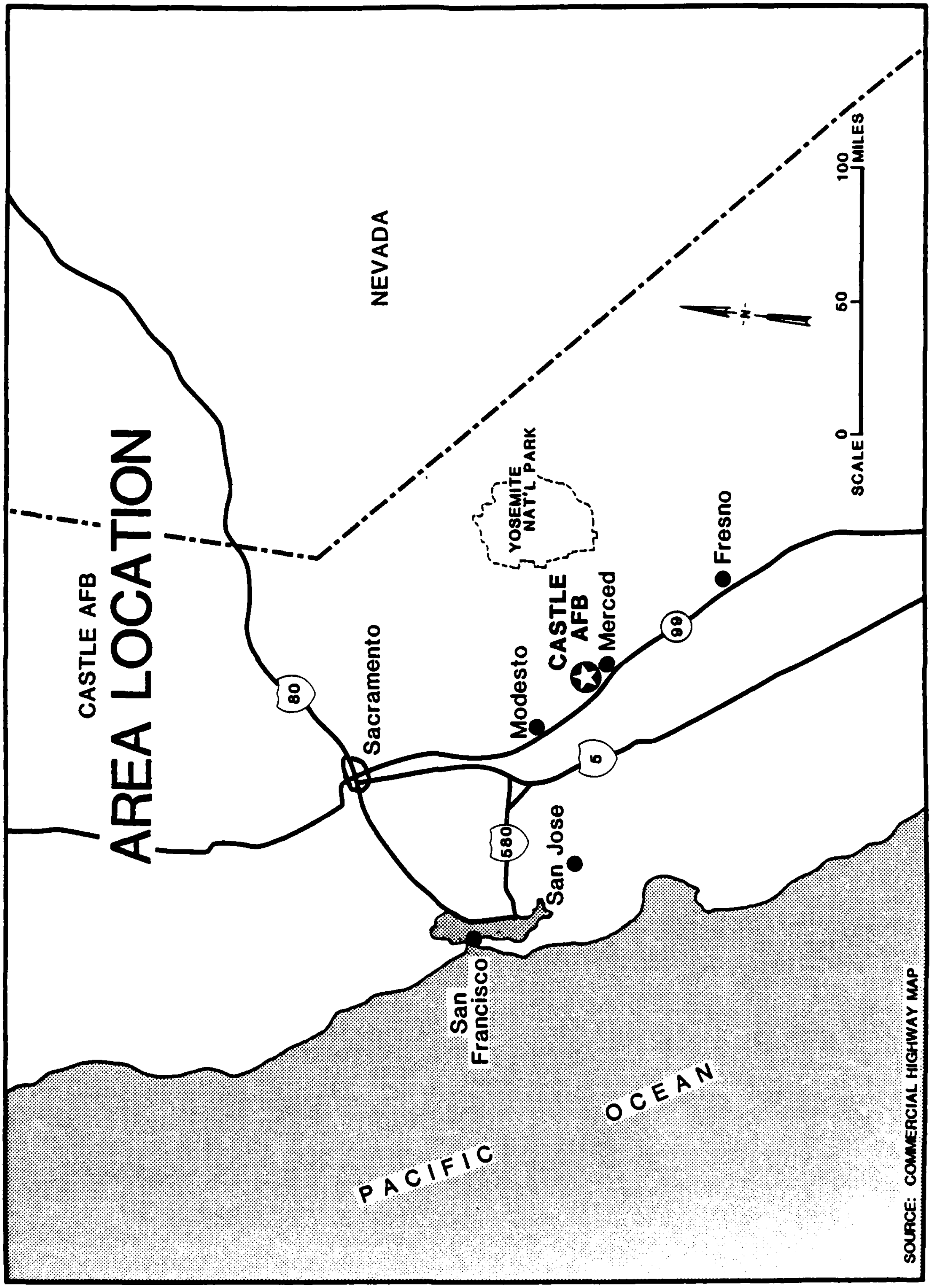
BASE HISTORY

Castle AFB was initially established as an Army air base in September 1941. In December 1941, the first aircraft arrived and flight training programs were initiated. The base reached its peak in aircrew training in mid-1944 when as many as 454 flying cadets graduated with each class. Between 1941 and 1945 more than 8,000 air cadets received their basic phase of flight training at Castle AFB. In 1945, all flying personnel and aircraft were transferred.

FIGURE 2.1

ES ENGINEERING-SCIENCE

FIGURE 2.2



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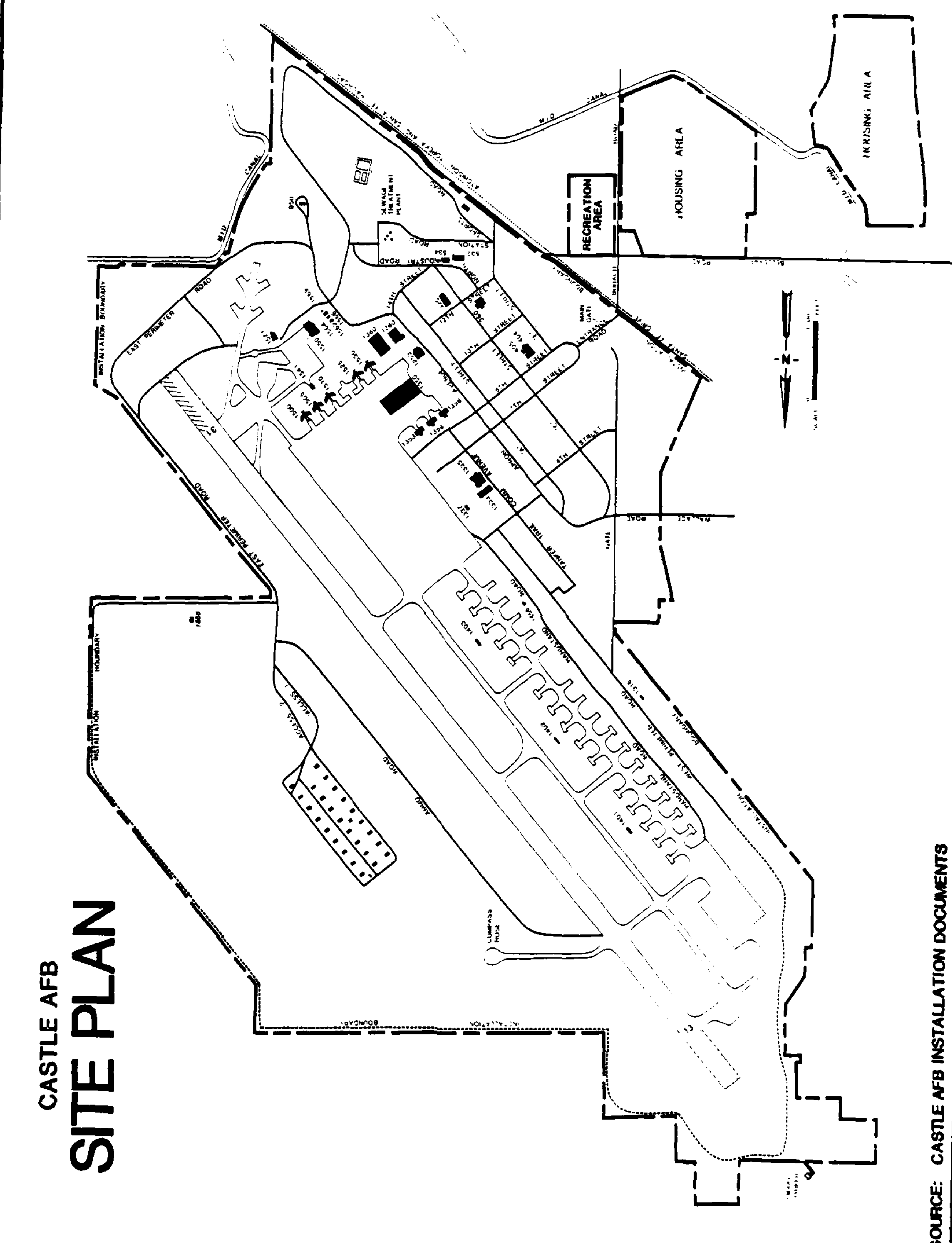


CASTLE AFB
SITE PLAN

SOURCE: CASTLE AFB INSTALLATION DOCUMENTS

In February 1946, the 59th Weather Reconnaissance Squadron (WRS) arrived on Castle and started weather operations with B-29, B-17 and C-54 aircraft. The Strategic Air Command assumed responsibility of the field in April 1946, and the 93rd Bombardment Group was assigned to the base in June; however, the group remained a "paper" unit until early 1947, when B-29s were assigned to the group. In July, SAC activated the 93rd Bombardment Wing at Castle AFB. In January 1948, SAC redesignated the installation with its current name, Castle Air Force Base.

The 93rd Bombardment Wing received B-50's in June 1949. In 1954, B-47's were assigned to the Wing and in 1955 the B-52's first arrived at Castle AFB. Shortly after the B-52's arrived, the Wing started training B-52 crews for SAC.

The mission was again modified in May 1957 with the arrival of the KC-135 stratotanker and subsequent increase in the training program to include tanker crews.

ORGANIZATION AND MISSION

The primary mission of the 93rd Bombardment Wing is the development and maintenance of a combat-ready force capable of conducting long-range bombardment operations. Additionally the 93rd trains all B-52 stratofortress (G and H Series) and KC-135 stratotanker combat crews for SAC. The Wing is also responsible for operating Castle AFB and supporting the various tenant units at the base.

The tenant organizations at Castle AFB are listed below. Descriptions of the major base tenant organizations and their missions are presented in Appendix C.

84th Fighter Interceptor Squadron
318th Fighter Interceptor Squadron, Det. 2
SAC Management Engineering Team
2035th Communications Squadron
Det. 1, 4200 Test and Evaluation Squadron
Det. 412, Air Force Audit Agency
Field Training Det. 514
Det. 2, 9th Weather Squadron
Det. 1, 323 Flying Training Wing

SECTION 3

ENVIRONMENTAL SETTING

The environmental setting of Castle Air Force Base described in this chapter focuses on those features that may influence or be influenced by the migration of hazardous contaminants. Since 1977, Castle AFB has conducted an extensive sampling program on the soils, surface waters and ground waters to identify the chemical constituents in the shallow ground water. As a result, a site-specific data base is available for description of the base environment both in terms of surface and subsurface conditions.

METEOROLOGY

Temperature and precipitation data are presented in Table 3.1 for the Merced area. The summarized data indicate an average annual precipitation of 12.23 inches. The computed annual evaporation rate at Merced is 53 inches annually. The computed net precipitation is minus 41 inches. The one-year 24-hour rainfall is 1.25 inches (NOAA 1968).

About 90 percent of the rainfall occurs from November to April. During the past eight years, California has experienced some wide fluctuations in precipitation, with very low and very high amounts. Figure 3.1 presents a histogram of fluctuations in total annual rainfall from 1975 to 1982.

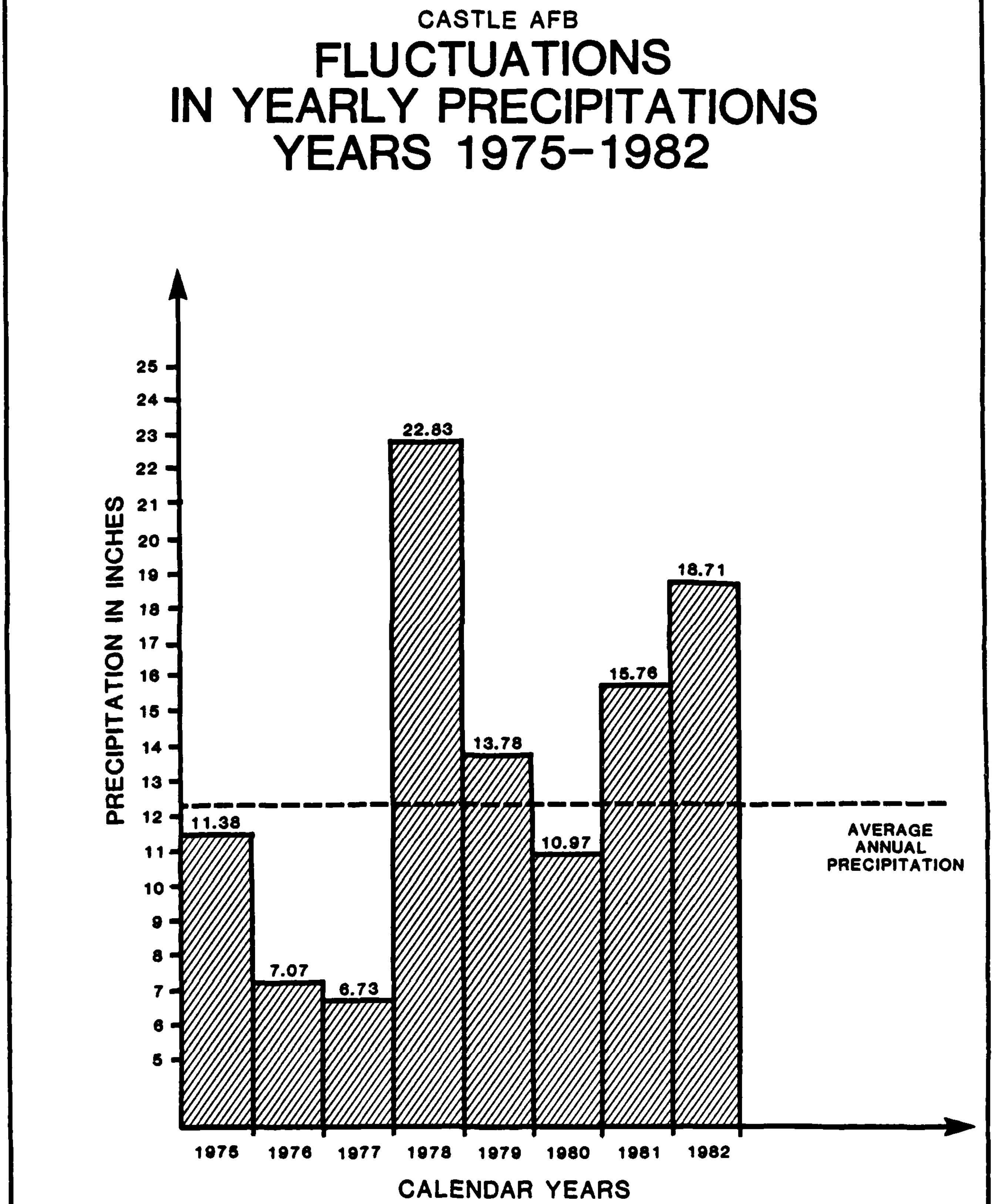
GEOGRAPHY

Castle AFB is located in the San Joaquin Valley which, together with Sacramento Valley to the north, constitutes the Great Central Valley of California. The Great Valley extends northwesterly from Bakersfield in the south to Red Bluff in the north; it is about 60 miles across, and is bordered to the east by the Sierra Nevada Mountain foothills and to the west by the Coast Ranges. The San Joaquin River drains the San Joaquin Valley flowing northerly to the Sacramento-San

TABLE 3.1
CASTLE AFB CLIMATIC CONDITIONS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<u>Temperature</u>[1]												
Average	45.6	49.4	53.3	59.5	66.3	74.1	80.0	78.0	72.3	63.3	53.5	46.7
Absolute min	16	21	23	28	32	40	40	41	35	28	21	16
Absolute max	77	84	87	96	109	111	116	114	110	102	90	76
Yearly Average 61.8 - Max 116 - Min 16												
<u>Precipitation</u>												
Average monthly[2]	2.24	2.05	1.94	1.10	0.42	0.08	0.02	0.02	0.15	0.56	1.34	1.89

[1](SCS 1950) based on 55 years of record at Merced Fire Station, elevation 169 feet.
[2]Department of Water Resources Station No. 72481, based on 86 years of record, 1896-1983.



SOURCE: CALIFORNIA DEPARTMENT OF WATER RESOURCES STATION NO. 72481

ES ENGINEERING-SCIENCE

Joaquin Delta for eventual discharge through San Francisco Bay into the Pacific Ocean (see Figure 3.2 for location of physiographic provinces surrounding Castle AFB).

The San Joaquin Valley is one of the largest agricultural areas in California, providing agricultural products to California and all of the United States. The major crops grown in Merced County around the base are grain, rice, cotton, grapes, almonds, figs, peaches, sweet potatoes, and tomatoes. Cultivation of the diverse range of agricultural products has been made possible by extensive and intensive irrigation.

TOPOGRAPHY

Elevations at the Central Valley bottom, west of Castle AFB are at approximately 90 feet above the National Geodetic Vertical Datum of 1929 (NGVD). The topography is gently rising from west to east into the foothills of the Sierra Nevada Mountains and reaches elevations up to 13,000 feet at the surface-water drainage divide. The base has a relatively flat terrain. Elevations at the base range from about 195 feet NGVD along the northeastern boundary to about 165 feet NGVD along the southwestern boundary.

DRAINAGE

All surface runoff on the base is collected within the storm drainage system. This system, consisting of open and enclosed channels, conveys all the runoff to the southeastern corner of the base. At this point two open channels meet and the runoff is contained behind a concrete wall. This wall acts as a barrier to flows, and only during heavy rains is water discharged off the base. At all other times, water is ponded for evaporation and infiltration into the ground. During times of discharge, the runoff is culverted under Santa Fe Drive, the Santa Fe Railroad tracks, and the Livingston Canal. Under normal conditions, runoff from rainfall events discharges to Canal Creek, but during extreme storms partial discharge occurs to Livingston Canal. Flows in Canal Creek discharge to Black Rascal Creek, a tributary to Bear Creek; flows in the Livingston irrigation canal eventually discharge to the Merced River. Figure 3.3 depicts the regional watershed. This figure shows the location of major creeks receiving runoff from the base. The

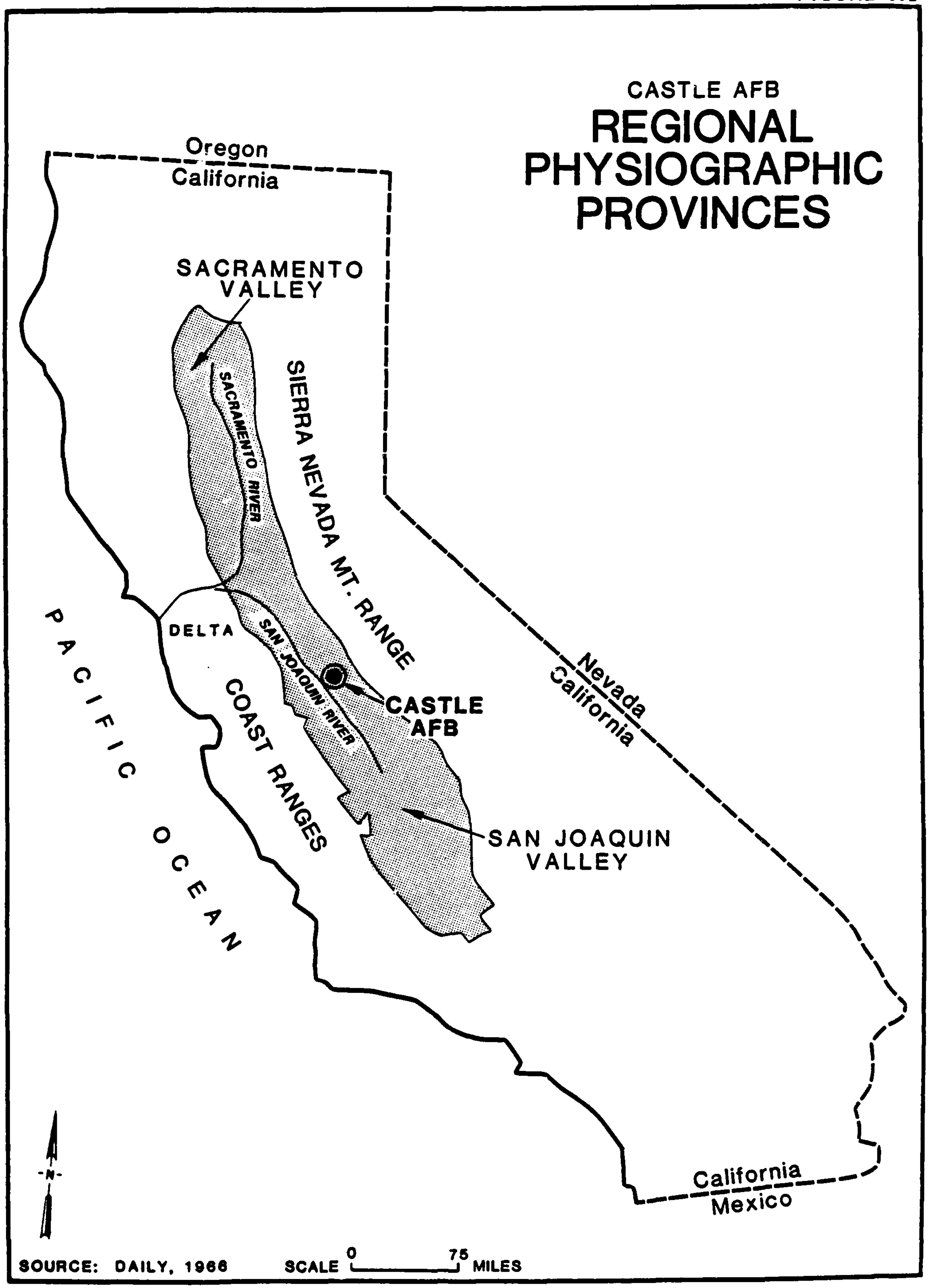
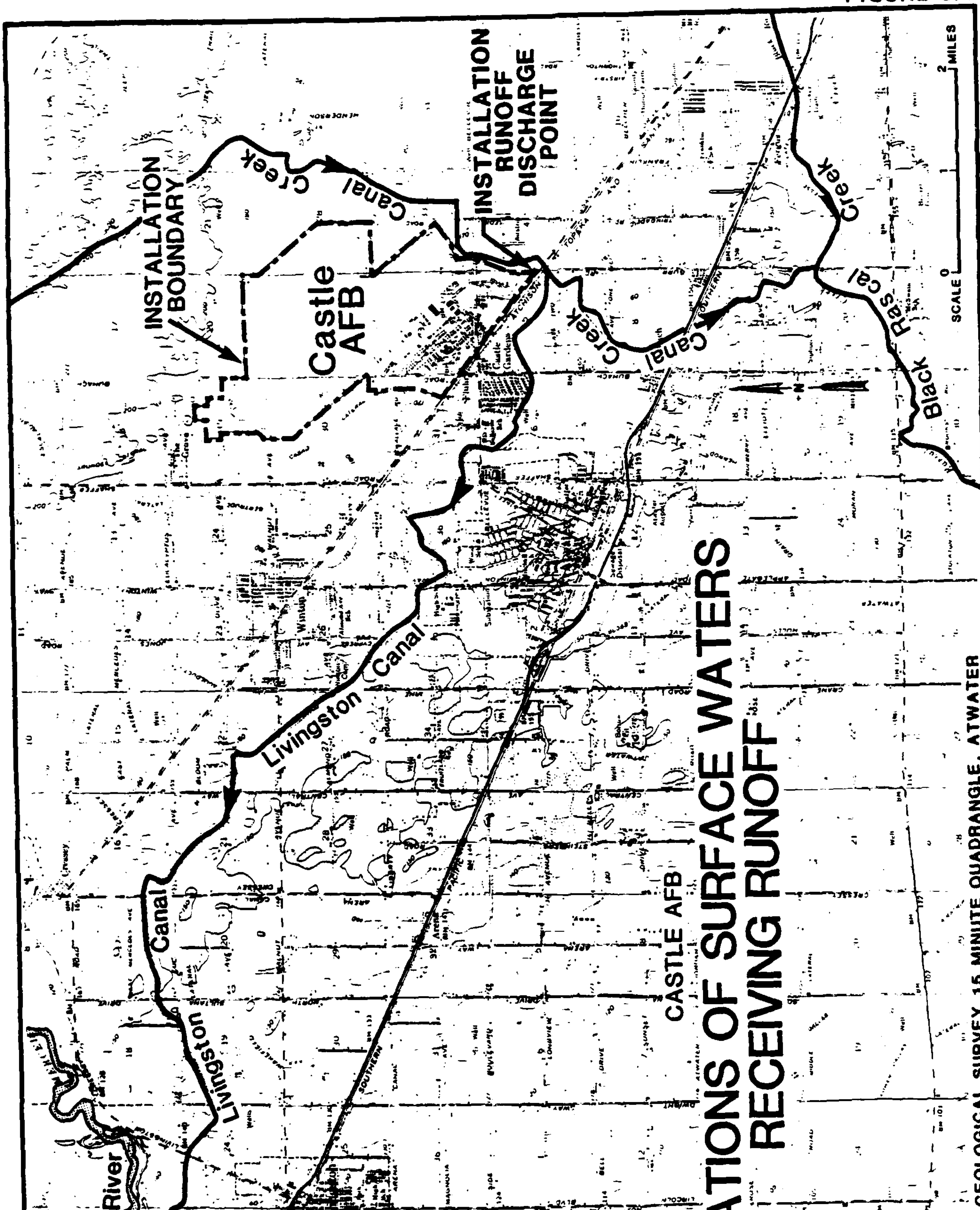

CASTLE AFB
REGIONAL PHYSIOGRAPHIC PROVINCES
Oregon
California
SACRAMENTO VALLEY
SACRAMENTO RIVER
SIERRA NEVADA MT. RANGE
DELTA
SAN JOAQUIN RIVER
CASTLE AFB
Nevada
California
PACIFIC OCEAN
COAST RANGES
SAN JOAQUIN VALLEY
California
Mexico
N
SOURCE: DAILY, 1966
SCALE 0 75 MILES

FIGURE 3.3



CASTLE AFB
LOCATIONS OF SURFACE WATERS RECEIVING RUNOFF

SOURCE: U.S. GEOLOGICAL SURVEY 15 MINUTE QUADRANGLE, ATWATER

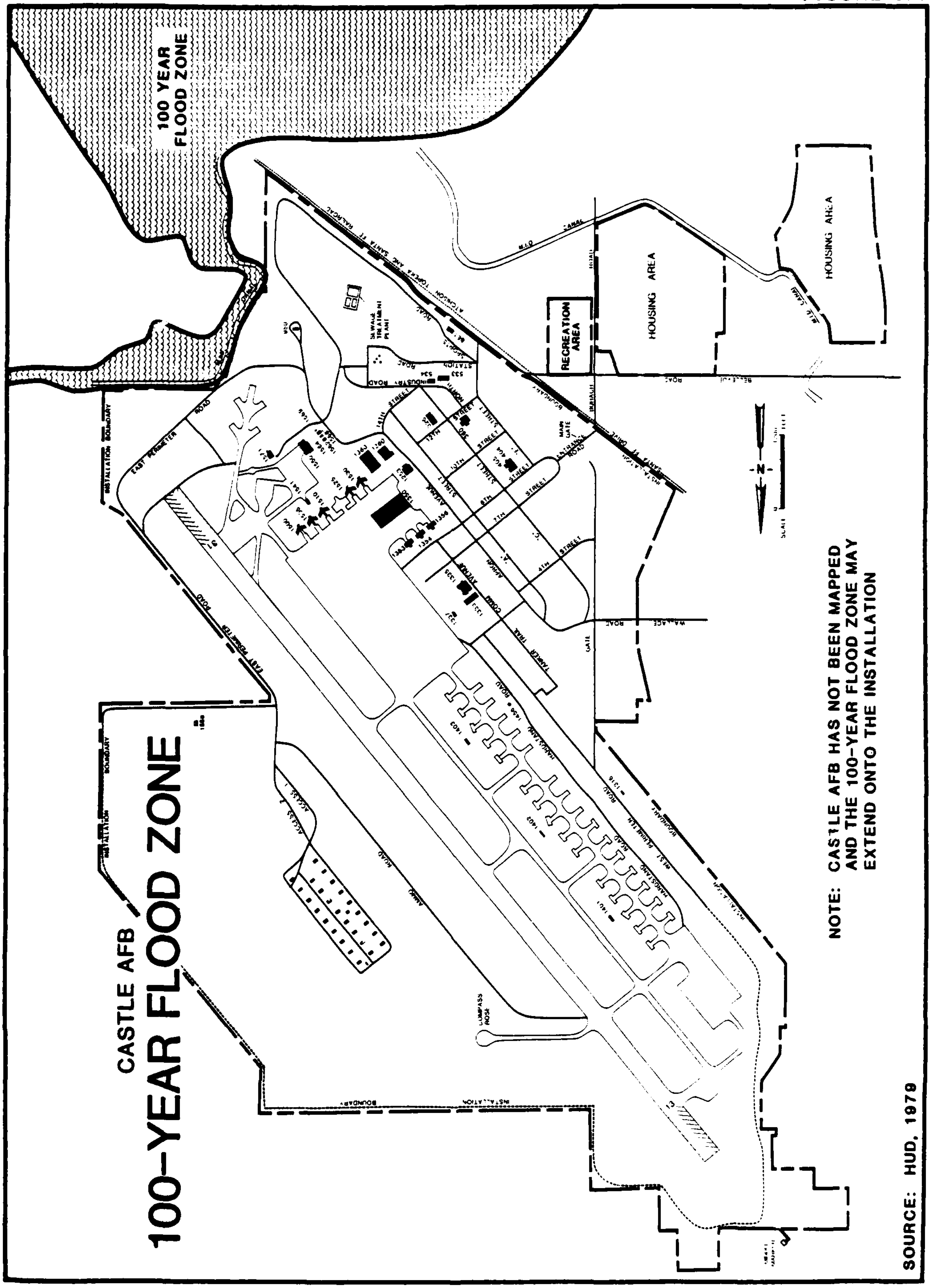
Livingston Canal is operated by the Merced Irrigation District. It provides irrigation water for agriculture in the areas south and northwest of the installation. The sides of the canal are lined with concrete in some places, for erosion control; however, the bottom is not lined. The canal therefore serves as recharge to the surrounding area (Larimer 1983). Seasonal water level fluctuations in the canal are minimal; flows in the winter are mainly from precipitation runoff and in the summer from irrigation returns.

The 100-year flood plain has not been delineated by the U.S. Department of Housing and Urban Development (HUD 1979) at Castle AFB. However, areas adjacent to the base have been mapped and are within the 100-year flood plain (zone C: minimal flooding 12 inches or less); part of the base may be within this same zone designation. Figure 3.4 shows the 100-year flood zone adjacent to Castle AFB. There are no identified wetlands areas on the base (Sibilsky, 1983).

SURFACE SOILS

The U.S. Department of Agriculture, Soil Conservation Service (SCS 1950) has identified and mapped the soils in the Merced area; however, no detailed mapping was conducted for Castle AFB proper. The regional mapping has identified the base to be underlain by the Delhi-Atwater Soil Association. Most of the soils mapped adjacent to the base belong to the "Atwater loamy sand, deep over hardpan, 0 to 3 percent slopes." The Atwater soils are formed from sandy, granitic, alluvium, and deposited either by wind or water. The soils are characterized by a coarse-textured surface soil, generally sand or loamy sand, a deep profile, and a pale-brown subsoil. In some places the subsoil consists of lenses of heavy sandy loam or sandy clay loam at depths of 2 to 4 feet. The most striking characteristic of this soil group is the presence of an iron-silica cemented hardpan at depths of 3-1/2 to 5 feet. The Atwater surface soils are generally well-drained (SCS 1950).

There is one soil type in the Atwater Soil Association bordering Castle AFB which does not contain hardpan at depth, the "Atwater loamy sand, 0 to 3 percent slope" (Burnham, 1983). The location of this soil


CASTLE AFB
100-YEAR FLOOD ZONE
100 YEAR FLOOD ZONE
RECREATION AREA
HOUSING AREA
HOUSING AREA
NOTE: CASTLE AFB HAS NOT BEEN MAPPED AND THE 100-YEAR FLOOD ZONE MAY EXTEND ONTO THE INSTALLATION
SOURCE: HUD, 1979

is included on Figure 3.5, and its possible extension onto the southernmost portion of the base is inferred.

A large number of shallow soil boring logs are available from Castle AFB, Civil Engineering. The borings were completed during foundation studies for structures on the base. The boring depths range from a few feet to 30 feet, with an average depth of about 12 feet. The logs indicate that the base is generally underlain by several feet of sand, silty sand, and sandy silt, with a decrease in grain size with depth. In places these materials are abruptly underlain by iron-silica cemented hardpan varying in thickness from one to more than five feet. When identified, the hardpan is generally found less than five feet from the ground surface. Figure 3.6 shows a cross-sectional view from the southwest to northeast of selective soil borings. The figure reveals that the hardpan is extremely variable within short distances. This could be due to faulty soil/hardpan recognition, too shallow borings, or the absence of hardpan. However, it is not uncommon to find discontinuous strata of hardpan in the area. As mentioned above, the Atwater loamy sand, 0 to 3 percent slope, which is not underlain by hardpan, may extend on the installation along the southern border. Hardpan may also be discontinuous through fracturing or through penetration in connection with construction and placement of buildings or underground utilities.

GEOLOGY

The geology of the San Joaquin Valley has been described by Dickinson and Rich (1972), Ernst (1970), Jennings (1966), and Page (1973), among others. Information developed by these authors as well as conversations with the U.S.G.S. staff form the basis for the following description of the geologic regime near Castle AFB.

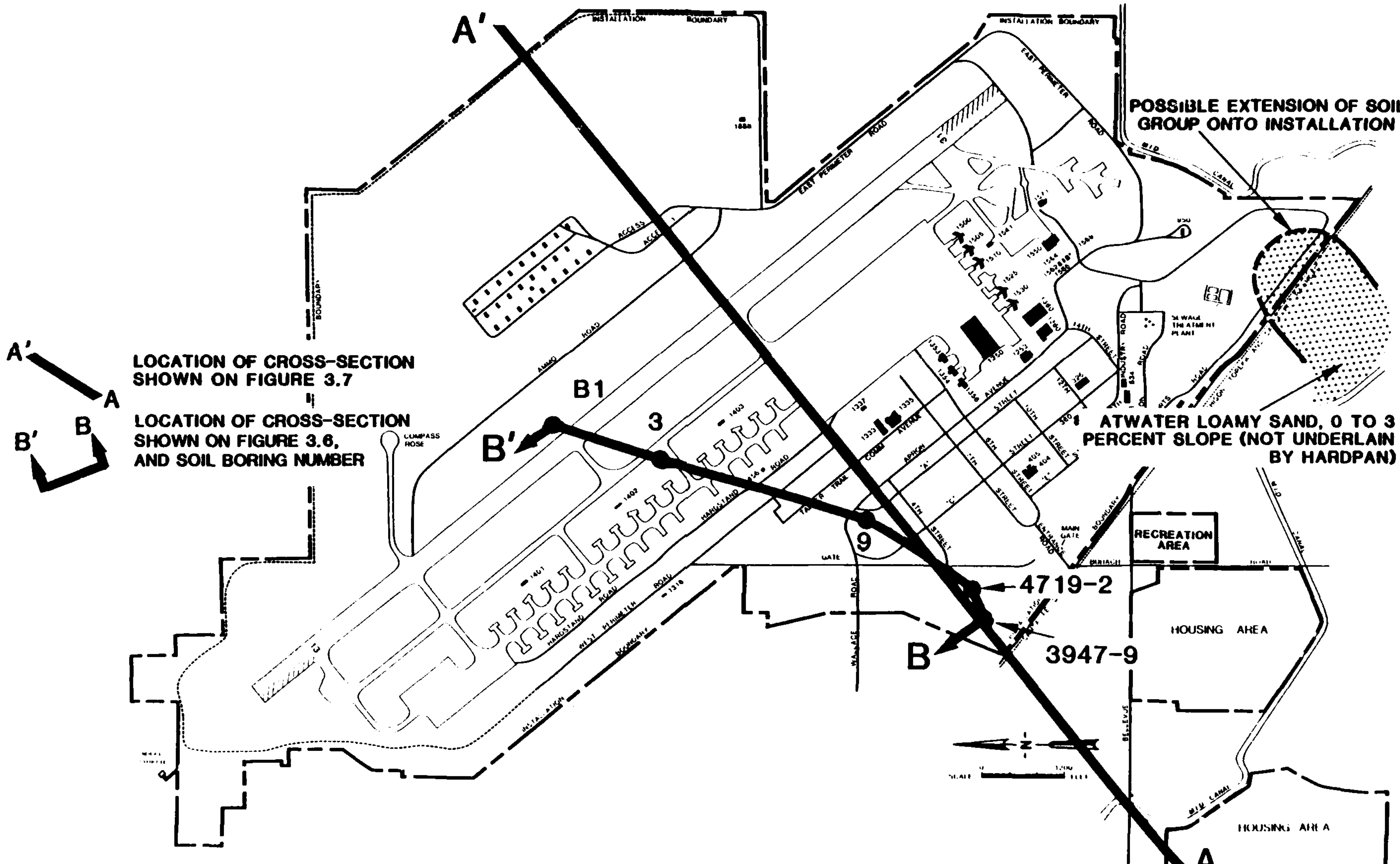
Geologic History

The base is underlain at depth by the Great Valley Sequence. The Great Valley Sequence consists of thousands of feet of sediments accumulated in a "trough" created over 100 million years ago when the Sierra Nevada Mountains to the east were forming. The newly exposed Sierra Nevada was a source of sediments to the Great Valley area, which at that time was below sea level and constituted the continental shelf. About

FIGURE 3.5

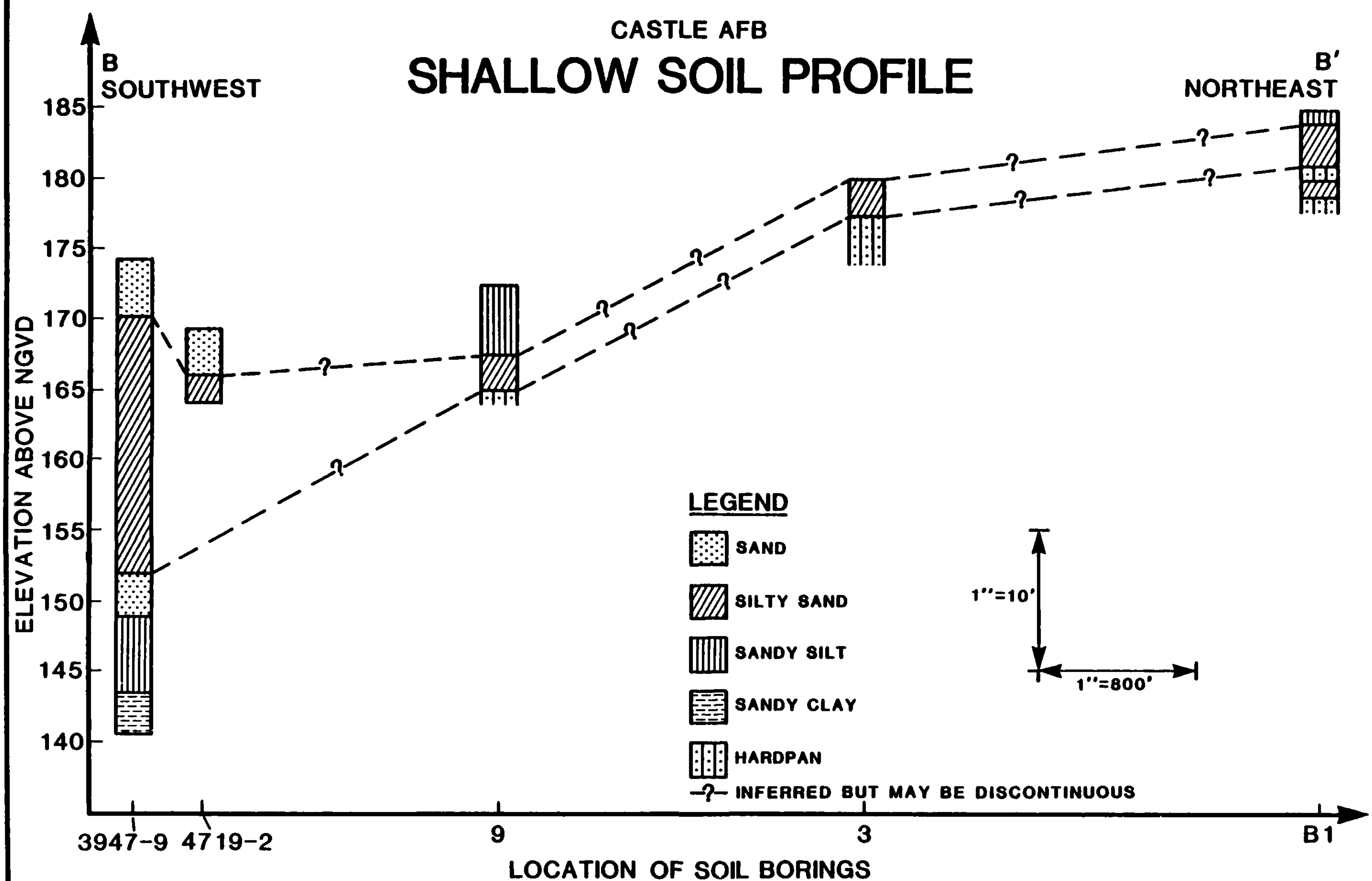
CASTLE AFB

GEOLOGIC CROSS-SECTION LOCATIONS



SOURCE: CASTLE AFB INSTALLATION DOCUMENTS

FIGURE 3.6



SOURCE: CASTLE AFB INSTALLATION DOCUMENTS

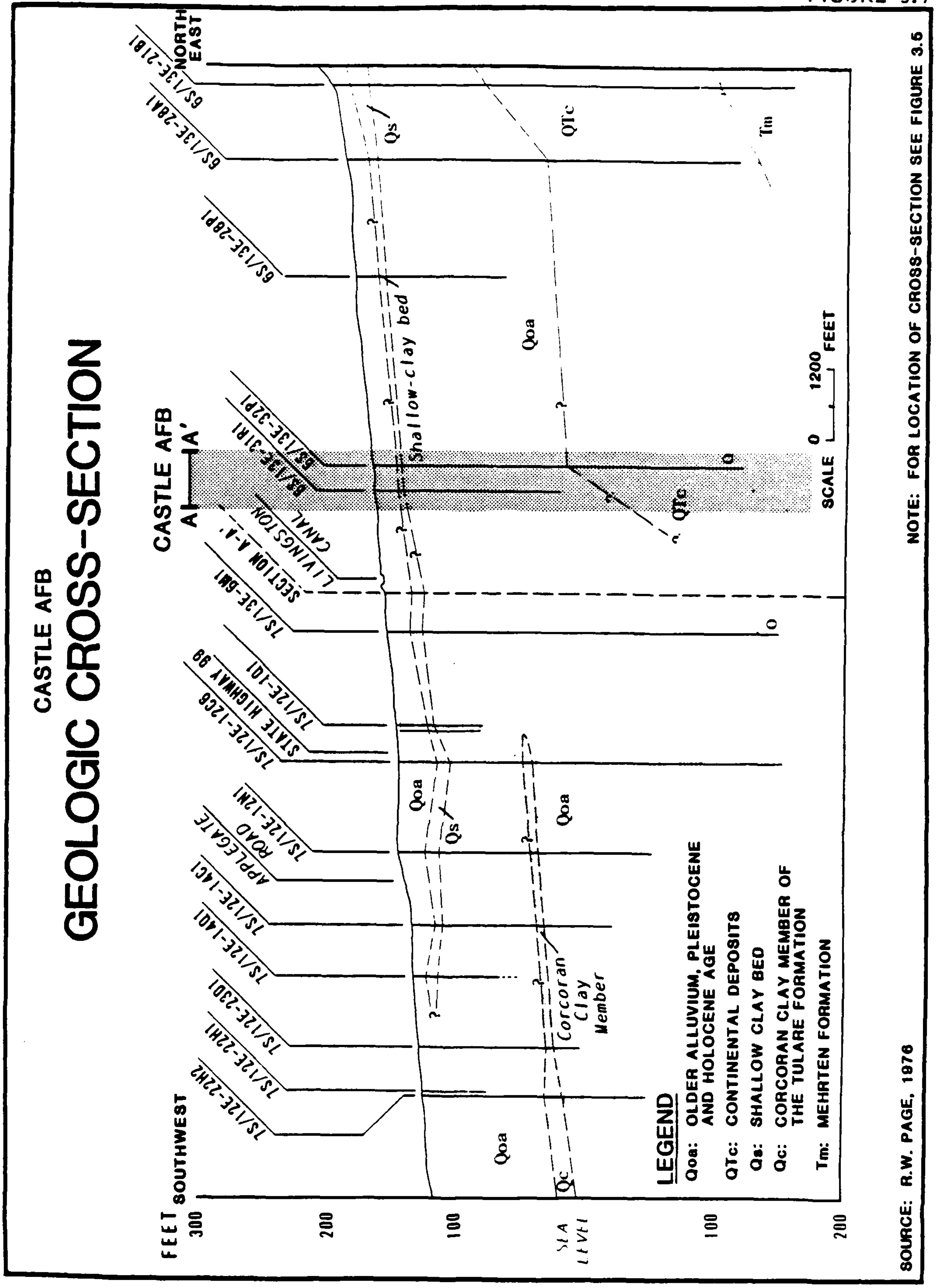
NOTE: FOR LOCATION OF CROSS-SECTION, SEE FIGURE 3.5

40 million years ago, the Coast Mountain Ranges along the Great Valley's western margin were formed, and the Great Valley became a closed basin receiving sediments from its eastern and western boundaries. Within the last couple of million years, alluvial fans were developed along the valley margins. The eastern alluvial fans were developed by streams and rivers carrying primarily granitic type fines, sands, and gravels down toward the Valley floor. Various climatic conditions and stream morphology resulted in sediments being deposited ranging in grain size from clays to cobbles, interfingering both laterally and vertically.

Stratigraphy

Rocks outcropping in the Merced area include basement complexes of pre-Tertiary age, consolidated rocks of Eocene, Miocene, and Pliocene age, and unconsolidated deposits of Pliocene, Pleistocene, and Holocene (recent) age. The base is underlain by older alluvium and continental unconsolidated deposits and consolidated rocks at depth. Figure 3.7 shows the geologic units at the base and vicinity. As indicated, the older alluvium extends throughout the base, bordered along the northwestern section by continental deposits. A geologic fence diagram on Figure 3.8 shows the regional subsurface conditions in part of the San Joaquin Valley, delineating the different geologic units overlying the basement rocks. Table 3.2 lists the lithology and water-bearing characteristics of both the unconsolidated deposits and consolidated rocks. The important geologic unit to notice is the lacustrine and marsh deposits of Pleistocene age. This deposit, consisting mainly of blue clays, is prevalent in the San Joaquin Valley and acts as a confining bed for ground water occurring under confined conditions. The deposits are also known as the Corcoran or "E" clays (Page 1973). On Figure 3.8, the approximate location of the base is indicated, and it can be seen that the Corcoran clay deposit is not underlying the base. In fact, it "pinches out" southwest of Atwater. Downgradient from the base the confined aquifer under the Corcoran clay is used for water supply. The installation and the adjacent areas being located along the margins of the Corcoran clay could be, in part, the recharge area for the underlying water-bearing deposits (Bertaldi, 1983). Additional field data is necessary to document this situation.

FIGURE 3.7

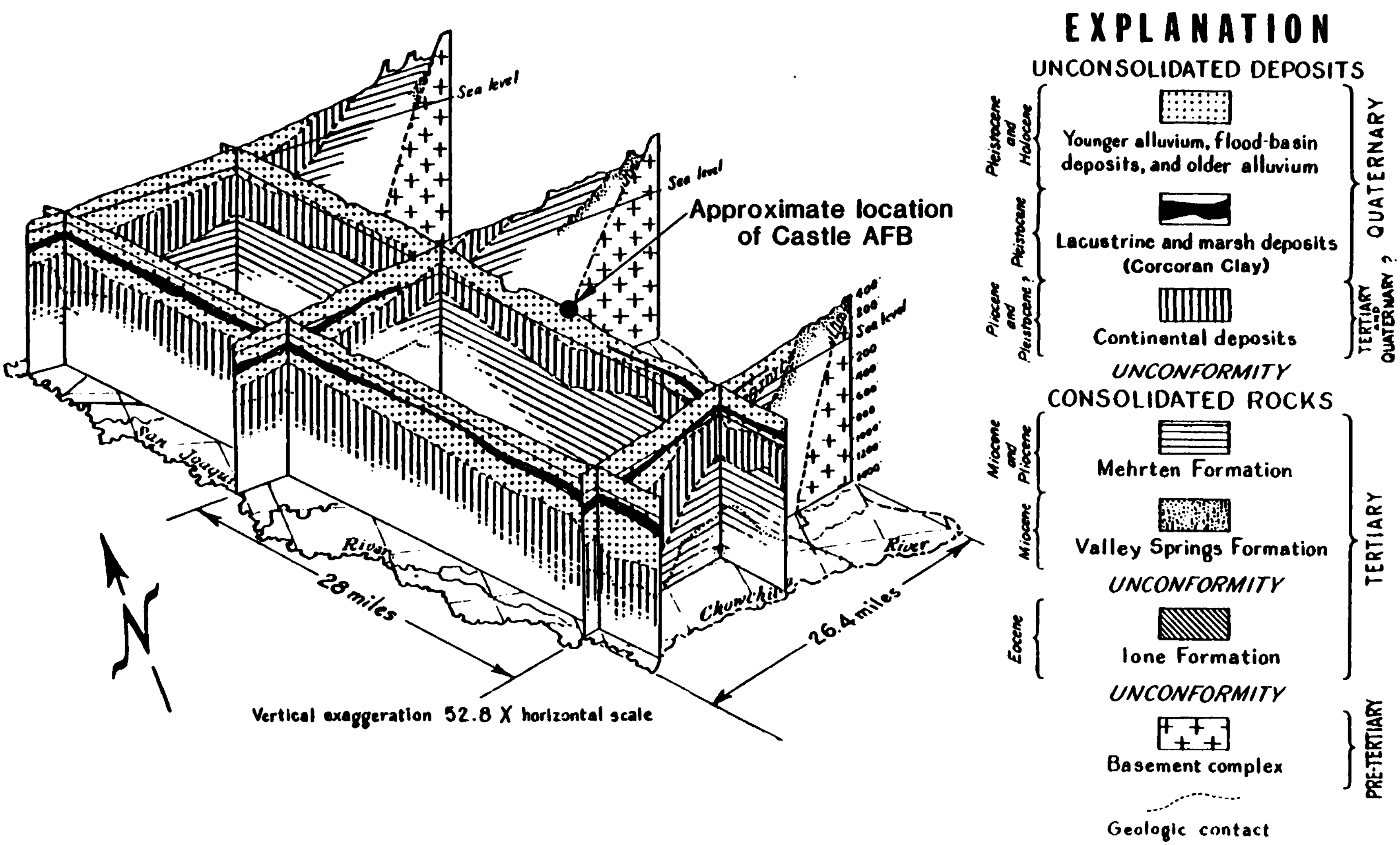


CASTLE AFB
GEOLOGIC CROSS-SECTION
CASTLE AFB
A
A'
SOUTHWEST
NORTH EAST
FEET
300
200
100
SEA LEVEL
100
200
1S/12E-22H2
1S/12E-22H1
1S/12E-23D1
1S/12E-14D1
1S/12E-14C1
APPLEGATE ROAD
1S/12E-12N1
1S/12E-12G6
STATE HIGHWAY 99
1S/12E-1Q1
1S/13E-6M1
SECTION A-A'
LIVINGSTON CANAL
6S/13E-31R1
6S/13E-32P1
6S/13E-28P1
6S/13E-28A1
6S/13E-21B1
Qoa
Qs
Qc
QTc
Tm
Shallow-clay bed
Corcoran Clay Member
SCALE
0
1200
FEET
LEGEND
Qoa: OLDER ALLUVIUM, PLEISTOCENE AND HOLOCENE AGE
QTc: CONTINENTAL DEPOSITS
Qs: SHALLOW CLAY BED
Qc: CORCORAN CLAY MEMBER OF THE TULARE FORMATION
Tm: MEHRTEN FORMATION
SOURCE: R.W. PAGE, 1976
NOTE: FOR LOCATION OF CROSS-SECTION SEE FIGURE 3.5

FIGURE 3.8

CASTLE AFB

FENCE DIAGRAM OF GENERALIZED GEOLOGIC UNITS



SOURCE: PAGE (1973)

TABLE 3.2

STRATIGRAPHY OF UNCONSOLIDATED DEPOSITS NEAR CASTLE AFB, CALIFORNIA

System and Series	Geologic Unit	Lithology	Range of Thickness (feet)	Water-Bearing Characteristics
		Unconsolidated Deposits		
QUATERNARY				
Holocene	Flood-basin deposits	Silt, clay, and fine sand, bluish-gray brown, and reddish-brown.	100	Low hydraulic conductivities and low yields to wells.
	Younger alluvium	Gravel, sand, and fine sand, some silt and clay, little or no hardpan; yellow, yellowish-brown, brown.	100	Moderate to high hydraulic conductivities, where saturated yields moderate quantities to wells. Unconfined.
Pleistocene & Holocene?	Older alluvium	Gravel, sand, silt, and clay, some hardpan; brown, reddish-brown, gray, brownish-gray, white, blue, & black.	400-700	Moderate to high hydraulic conductivities, yields to wells reported as high as 4450 gpm (gallons per minute); average yield to large wells 1900 gpm. Unconfined and confined.
Pleistocene	Lacustrine and marsh deposits	Silt, silty clay, and clay, gray and blue. (The Corcoran clay.)	100	Confining bed, very low hydraulic conductivities.
TERTIARY AND QUATERNARY?				
Pliocene & Pleistocene?	Continental deposits	Gravel, sand, silt, and clay; brown, yellow, gray, blue, and black.	450-700	Moderate to high hydraulic conductivities; yield to wells as large as 2100 gpm. Confined beneath lacustrine and marsh deposits.
		Consolidated Rocks		
TERTIARY				
Miocene & Pliocene	Mehrten Formation	Sandstone, breccia, conglomerate, tuff, siltstone, and claystone; brown, yellowish-brown, grayish-brown, pinkish-brown, pink, blue, yellow, green, gray, and black. Large amounts of andesitic material occurs in beds.	200-700	Low to moderate hydraulic conductivities. Yield to wells as high as 2100 gpm.
Miocene	Valley Springs Formation	Ash, sandy clay, and siliceous sand and gravel generally in clay matrix, tuff, siltstone, and claystone; yellow, yellowish-brown, reddish-brown, gray, greenish-gray, white, pink, green, and blue. Rhyolitic material occurs in beds.	900	Probably low hydraulic conductivities. Quality of water ranges from fair to poor.
Eocene	Ione Formation and other sedimentary rocks	Conglomerate, sandstone, clay and shale; partly marine; yellow, red, gray, and white.	800	Probably low to moderate hydraulic conductivities. In places reported to yield saline water.
CRETACEOUS	Marine sandstone and shale	Sandstone and shale.	9,500	Unknown. Reported to yield saline water.
PRE-TERTIARY	Basement complex	Metamorphic and igneous rocks.		Fractures and joints locally yield small quantities of water; otherwise virtually impermeable.

SOURCE: Modified from Page (1973).

Site-specific subsurface information is available from boring logs prepared during installation of water supply wells in 1939 and test wells installed by the Air Force in 1981. The well logs for the water supply wells are shown on Figure 3.9. Installation test well logs are contained in Appendix E and shown graphically later in Figure 3.11. These boring logs demonstrate the varied nature of the alluvial deposits with respect to sorting and grain size, thickness, and lateral extent, and the presence of hardpan at shallow depths. Generally, a red clay layer up to 100 feet thick is found at or below a depth of 100 feet. This layer may also be a confining clay creating an intermediate confined aquifer above the Corcoran clays.

There are no known active or inactive faults mapped within the Great Valley near the base (Jennings 1975).

HYDROLOGY

Ground water occurrences in the project region have been documented, among others, by the Department of Water Resources (DWR) (1980), DWR (1965), Londquist (1982), and Page (1973 and 1977). Additional information has been obtained through interviews with scientists and staff at:

- U.S. Geological Survey
- California Department of Health Services
- California Regional Water Quality Control Board, Central Valley Region, Fresno Section
- U.S. Environmental Protection Agency
- Merced Irrigation District

Regional Ground Water Regime

Castle AFB is located within the San Joaquin Basin Hydrologic Study Area in the Merced Sub-basin (DWR 1980). Ground water in the region occurs in four different aquifers:

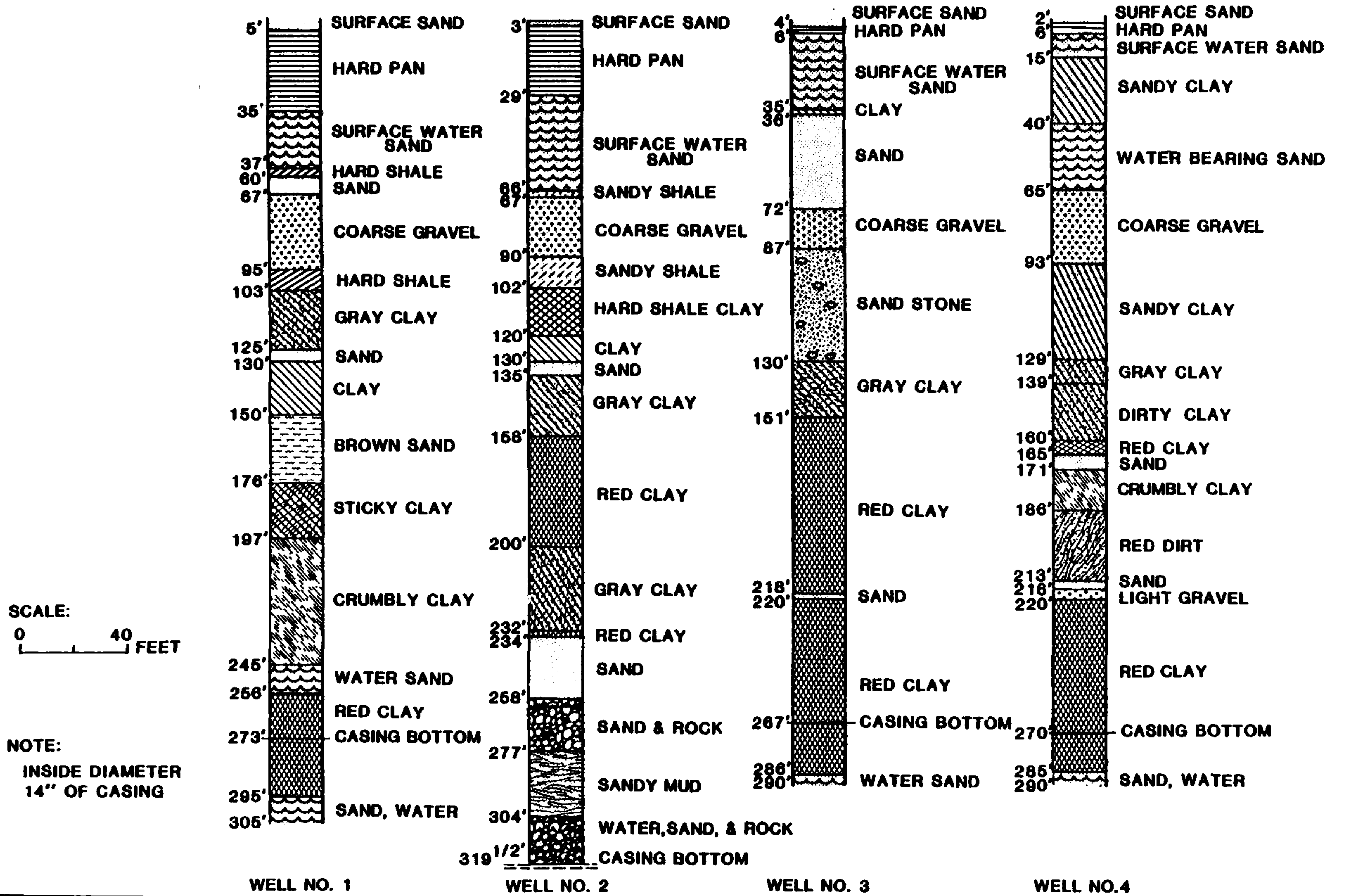
Perched Water Table

In areas underlain by hardpan, a perched, seasonal water table exists with limited communication with the underlying permanent water

FIGURE 3.9

CASTLE AFB

WELL LOGS FOR INSTALLATION WATER SUPPLY WELLS



table, except where fractured, broken, or discontinuous. Additional field data is necessary to document this information.

Unconfined Shallow Aquifer System

Ground water under unconfined conditions occurs in unconsolidated deposits above the Corcoran clay, where it is present, or possibly above an intermediate confining clay zone. Where the clays are absent, the base of the unconfined aquifer is in contact with the top of the Mehrten Formation, a consolidated deposit (Page 1973). Since the confined and unconfined aquifers blend imperceptibly into one essentially unconfined aquifer at the margins of the valley, the actual location of the change from confined conditions to unconfined conditions is difficult to locate (DWR 1960). Recharge to the unconfined aquifer occurs by deep infiltration of rainfall (and irrigation waters), by percolation from streams and irrigation canals, and/or by stream underflow at the margins of the valley; the latter probably being the major recharge source. Regional unconfined ground water movement in the San Joaquin Valley is generally from the east to west and southwest toward the valley trough, unless influenced by local pumping. Figure 3.10 shows the regional ground-water contours and the direction of movement toward the Merced and San Joaquin Rivers.

Intermediate Confined Aquifer System

Ground water under confined conditions occurs in unconsolidated deposits below the red, intermediate continuing clay or the Corcoran clay. Recharge to the confined aquifers is from percolation along the Valley margins from the unconfined aquifers, and possibly from deep, and extremely slow percolation through the clays (DWR 1960), when the hydraulic head of the confined aquifer is below that of the unconfined aquifers. Water moving through the red clays into the unconsolidated deposits below could eventually recharge the confined aquifer below the Corcoran clays. Water movement within the confined aquifer is probably to the west and southwest toward the valley trough (Page 1973).

Consolidated Rock Aquifer System

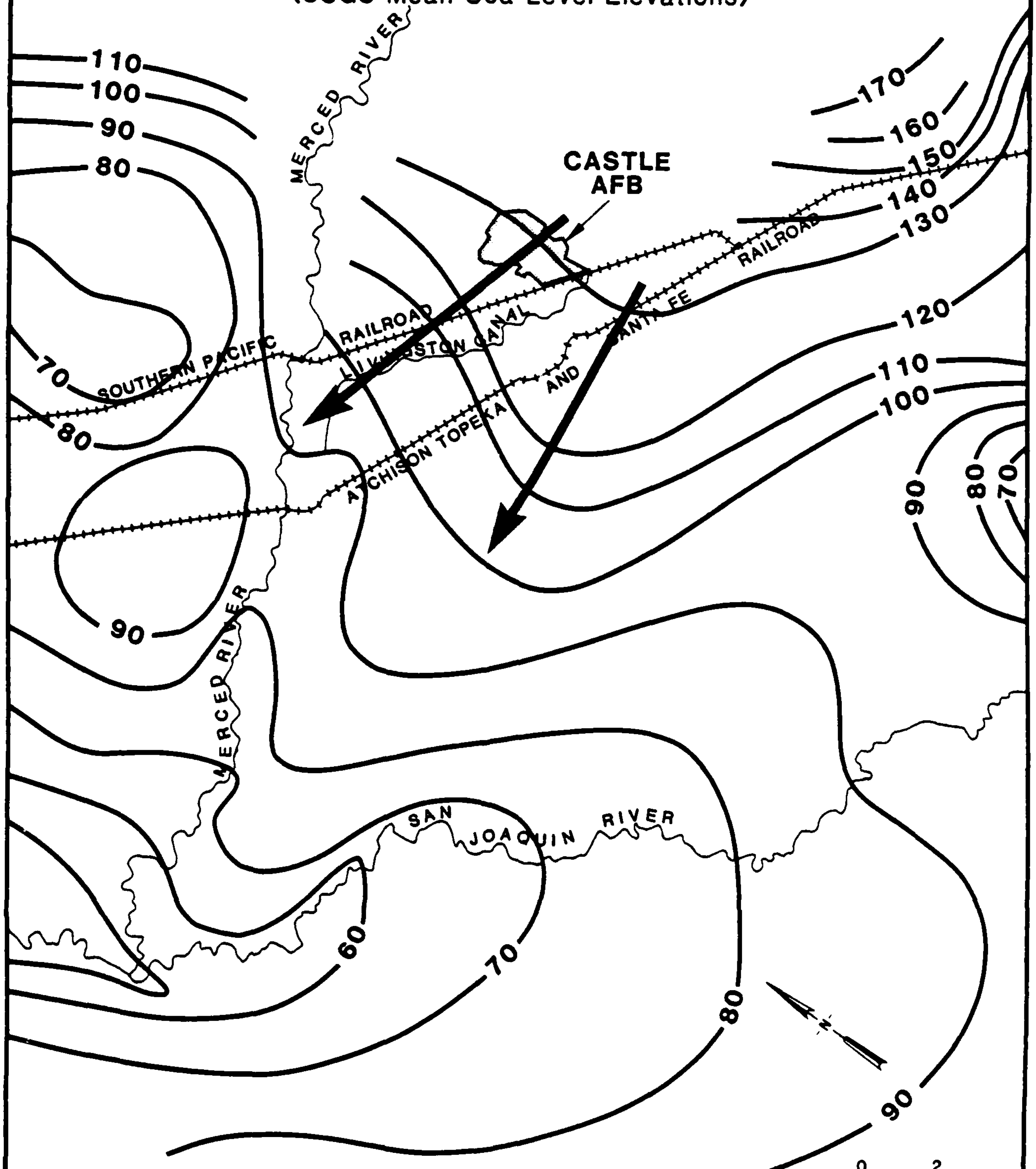
Confined ground water is contained in the consolidated rocks in the Ione, Valley Springs, and Mehrten Formations.

FIGURE 3.10

CASTLE AFB

REGIONAL GROUND-WATER CONTOURS FOR THE UNCONFINED AQUIFER - FALL 1980

(USGS Mean Sea Level Elevations)



SOURCE: CALIFORNIA DEPARTMENT OF WATER RESOURCES

SCALE 0 2 MILES

ES ENGINEERING-SCIENCE

Site Specific Ground Water Regime

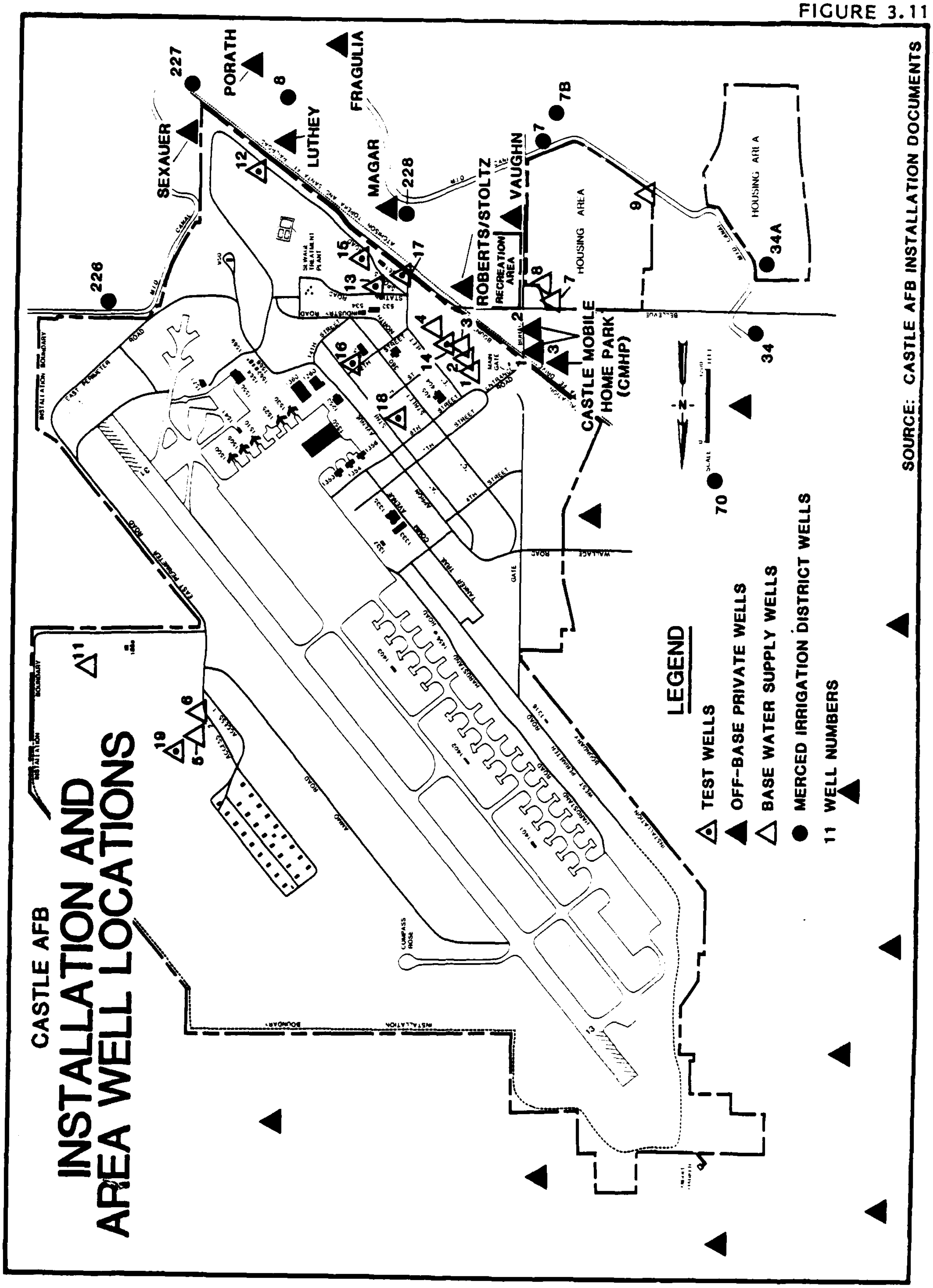
Introduction

In November 1981, the Air Force installed eight ground water monitoring wells to investigate potential ground water contamination from past disposal practices. The locations of these wells are shown on Figure 3.11. Elevations and ground-water elevations for each test well are listed in Table 3.3. Also shown is the location of adjacent private and public wells. The test wells were installed to depths of 95 to 100 feet, generally terminating in a red clay layer. All wells were screened in the bottom 10 feet, intercepting water-bearing sand or gravel in the shallow aquifer. The wells were grouted a minimum of 20 feet from the ground surface (Large 1983) (see Appendix E for well logs on the test wells). Data obtained from these wells have been used to describe the local shallow ground water on Castle AFB.

Perched Water Table

Shallow soil boring logs and well logs from the base indicate the depth to the hardpan as varying from 0 to 12 feet, with an average depth of approximately six feet. In places where the hardpan exists, a perched water table is likely to be present. The perched water table is recharged from precipitation during the winter months, year-round infiltration from Canal Creek/Livingston Canal along the south-southeastern border of the installation, and from irrigation of the spray field at the southern end of the base. The spray field consists of approximately 20 acres of land irrigated with an average of 0.5 million gallons per day (mgd) of treated wastewater effluent in accordance with Order 79-47 of the Regional Water Quality Control Board, Central Valley Region. On an annual basis, the 20-acre tree farm area would receive a total of 503 acre-feet of water; 20 acre-feet from precipitation (about 12 inches per year on 20 acres) and 573 acre-feet from wastewater irrigation, in addition to an unknown amount of infiltration from Canal Creek/Livingston Canal. Evaporation occurs at a rate of 90 acre-feet or 53 inches annually. The direction of movement from the spray field for this perched water table is probably controlled by topography and the Canal Creek/Livingston Canal recharge boundaries. It could therefore move in a north-northwesterly direction.

FIGURE 3.11



ES ENGINEERING-SCIENCE

TABLE 3.3
WATER LEVELS IN TEST WELLS
CASTLE AFB

Well	Elevation at Ground Surface Ft., NGVD	Water Level Depth in feet from ground surface	
		December 1981	March 1983
12	168.31	35.29	31.38
13	168.27	39.40	35.54
14	168.38	40.83	36.73
15	167.05	37.38	33.42
16	172.27	43.86	40.04
17	167.47	39.58	35.69
18	171.67	43.83	40.05

It is possible that the hardpan underlying the tree farm in particular and the base in general is discontinuous. In that case, the irrigation water would permeate to the unconfined shallow aquifer.

Unconfined Shallow Aquifer System

Water in the unconfined aquifer is found in sandy and gravelly deposits starting at depths of about 30 feet. The deposits vary in thickness but consist generally of sand overlying gravels, in total thicknesses of up to 55 feet (see Appendix E for well logs on base test wells and Figure 3.9 for logs on Base water supply wells). The deposits of saturated sands and gravels may be interconnected.

Based on water level measurements by the Base personnel in April 1983, the unconfined shallow ground water direction of movement is to the north-northwest as shown on Figure 3.12. The direction appears to be influenced by the Canal Creek/Livingston Canal acting as a recharge boundary to the shallow water-bearing sands and gravels.

Intermediate Confined Aquifer System

Below the shallow unconfined aquifer, where up to 100 feet of red clay has been identified in area well logs (see Appendix E), is a confined aquifer, termed "intermediate" by Page (1977). A cross section through the base on Figure 3.7 shows the intermediate confining clay layer. Water in this aquifer is locally confined, but the static water level in some wells in the area is below the elevation of the shallow clay bed. Where this occurs, the intermediate aquifer becomes unconfined (Page 1977).

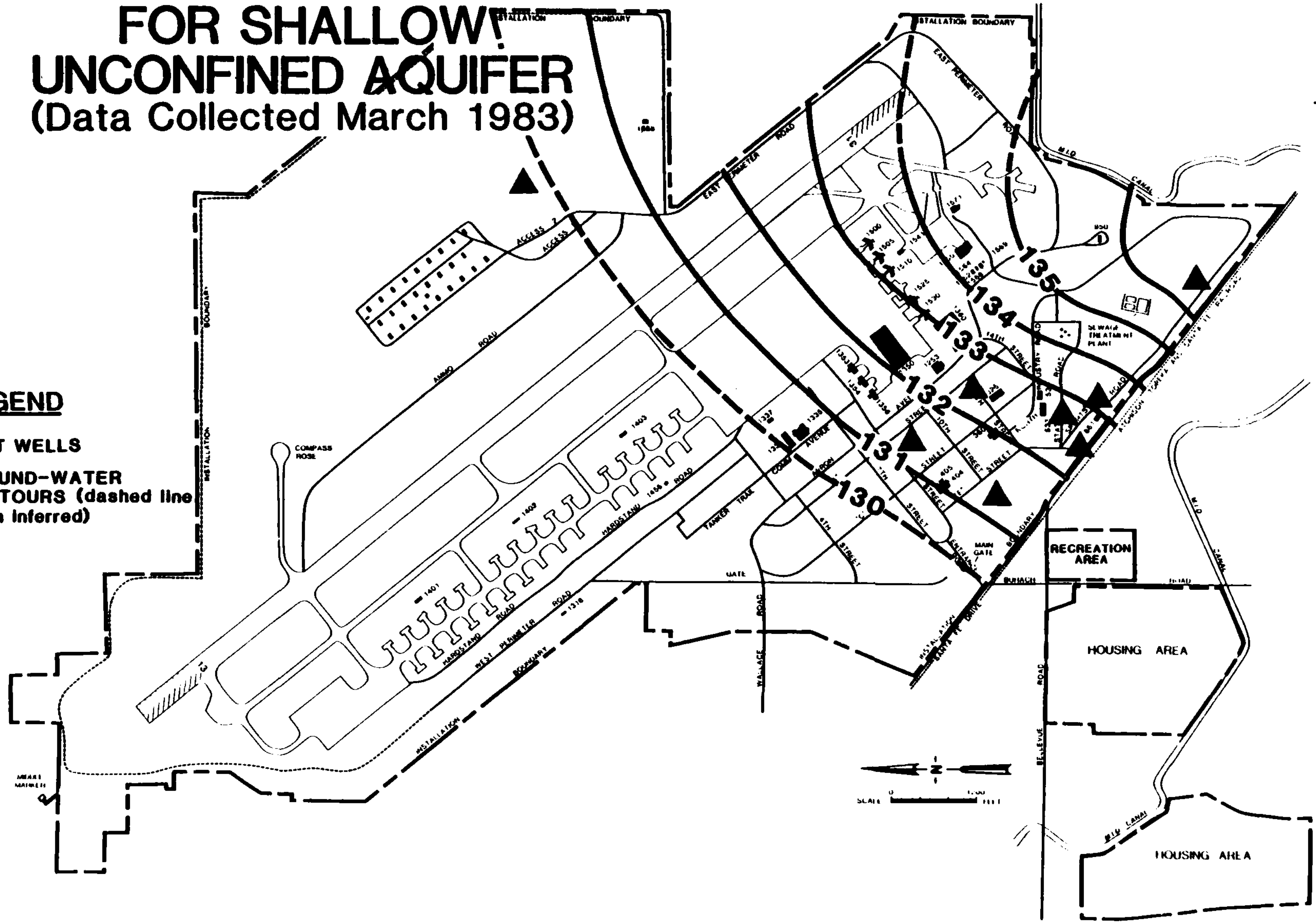
Recharge to the intermediate confined aquifer is from ground water inflow from the east and from downward leakage of water through the intermediate clay bed, and probably through some wells (Page 1977).

Installation and Area Wells

The base water demand is satisfied from ten on-base wells. The location of these wells is shown on Figure 3.11. Table 3.4 shows the available information on the construction details for these wells. The wells do not have gravel packs, and only Well No. 2 has data identifying the perforations in the casing, at the bottom 20 feet of the well. The wells were probably installed using cable tool method since that method was most used during the times they were installed. Even though the

FIGURE 3.12

CASTLE AFB
GROUND-WATER LEVEL CONTOURS FOR SHALLOW UNCONFINED AQUIFER
(Data Collected March 1983)



LEGEND

▲ TEST WELLS

— — — GROUND-WATER CONTOURS (dashed line when inferred)

SOURCE: CASTLE AFB INSTALLATION DOCUMENTS

NOTE: ELEVATIONS ARE TO USGS NGVD DATUM OF 1929

TABLE 3.4

CONSTRUCTION DETAILS FOR INSTALLATION WATER SUPPLY WELLS

Well	Year of Construction	Total Depth (feet)	Casing Depth (feet)	Casing Perforation Intervals (feet)	Construction Method	Well Diameter (inches)	Well Capacity (gpm)	PG&E Well Efficiency Test May 1983 (gpm)	Elevation feet NGVD
1	1939	273	273	none	cable tool	14	1600	850	N.D.
2	1939	319.5	314	299-319.5	cable tool	14	1600	922	N.D.
3	1939	290	267	N.D.	cable tool	14	1600	806	N.D.
4	1939	290	270	N.D.	cable tool	14	1200	587	N.D.
5	1956	120	76	N.D.	cable tool	8	35	N.D.	N.D.
6	N.D.	120	76	N.D.	cable tool	8	35	N.D.	N.D.
7	1951	260	260	N.D.	cable tool	14	500	N.D.	168.64
8	1951	300	290	N.D.	cable tool	16	1200	N.D.	167.14
9	1951	300	285	N.D.	cable tool	16	1200	N.D.	167.85
11	1954	80	80	N.D.	cable tool	10	25	N.D.	178.95

N.D. = No data.

Source: Castle AFB Installation Documents.

wells are not gravel-packed, the annulus surrounding the casing would have been disturbed during well installation, and could constitute a more permeable zone than the surrounding subsurface material. A video-scan was recently performed on Well 3 to investigate whether the casing was faulty. The scan did not detect any irregularities in the casing.

The main base is served by Wells 1, 2, 3, and 4, with Wells 1 and 2 being the primary water-producing wells. Only during high demands is Well 4, and lastly Well 3, used. Wells 5 and 6 are located in the weapons and ammunitions storage area and are low capacity wells. Wells 7, 8, and 9 supply water to the base housing area of Castle Gardens, but are tied into the main base water supply system to serve as a back-up supply. Well 11 serves a toilet facility at the firing range.

Area wells consist of private wells for domestic use and public wells from Merced Irrigation District (M.I.D.) are used for agricultural and dewatering purposes.

Private area wells are identified in Figure 3.11; available well construction data are summarized in Table 3.5. As can be seen, all the private wells penetrate into the shallow unconfined aquifer. The water level in private wells has reportedly varied as much as 30 feet due to vicinity dewatering wells.

The M.I.D. wells located on Figure 3.11 are penetrating into both the shallow ground water and the deeper-lying, water-bearing materials. Well logs for these wells are contained in Appendix E. By heavy pumping from both the shallow unconfined aquifer and the intermediate confined aquifer, the M.I.D. wells in the vicinity of the base may influence ground-water flow direction. The well logs for the deeper wells do not identify the presence of Corcoran clay, which has a diagnostic blue or green color. The construction details and water levels are listed in Table 3.6. As can be seen, the wells in the deeper aquifer generally have water levels below those of the shallow wells, indicating that the hydraulic head of the deeper aquifer is below the hydraulic head of the shallow aquifer. Therefore a potential exists for vertical downward movement of ground water.

TABLE 3.5

CONSTRUCTION DETAILS FOR AREA PRIVATE WELLS
(for location of wells see Figure 3.11)

Well	Well Depth (feet)	Elevation (ft. NGVD)	Drilling Method
CMHP-1	N.D.	N.D.	cable tool
CMHP-2	60	N.D.	cable tool
CMHP-3	140 (51-foot cement seal)	N.D.	N.D.
Roberts/Stoltz	85	N.D.	N.D.
Magar	103	171.66	N.D.
Luthey	114	N.D.	N.D.
Sexauer	100	169.22	N.D.
Vaughn	85	N.D.	N.D.
Porath	N.D.	N.D.	N.D.
Fragulia	N.D.	N.D.	N.D.

N.D. = No data.

TABLE 3.6

WELL CONSTRUCTION DETAILS
SELECTED MERCED IRRIGATION DISTRICT WELLS
(for well location see Figure 3.11)

M.I.D. Well No.	Year of Construction	Total[a] Depth (feet)	Depth to Water (feet) 1980 (Dec)	1981 (Dec)	1982 (Dec)
7B	1967	240	running	40.0	35.4
8	1923	83-1/2	32.2	31.5	28.9
34	1922	84	40.3	40.3	50.4
34A	1940	96	32.2	30.4	27.0
70	1928	93	35.2	35.0	33.8
225-P	1965	171	38.8	40.8	36.4
226-P	1965	206	37.5	37.2	35.0
227-P	1965	188	38.0	37.2	35.5
228-P	1965	292	38.4	38.1	35.1
237-P	1966	608	64.7	66.5	68.7

[a]Wells are not screened (Larimer 1983).

WATER QUALITY

Ground Water Quality

The quality of ground waters at the base has been monitored by sampling of water supply wells as well as by test wells installed on the Installation in 1981. In addition, the ground water quality of adjacent private wells has been monitored since 1980.

The water quality parameters for which monitoring was conducted consisted of volatile halocarbons, volatile aromatics, herbicides, and selected metals (arsenic, chromium, lead, and mercury). The analytical tests detected concentrations of the compounds listed below. The respective range of concentrations detected for each of the compounds is listed alongside the compound name:

Trichloroethylene (TCE)	ND - 136 ug/l
Trans-1,2-Dichloroethene	ND - 9.3 ug/l
Carbon tetrachloride	ND - 0.4 ug/l
Chloroform	ND - 1.1 ug/l
Dibromochloromethane	ND - 1.5 ug/l
Bromoform	ND - 2.6 ug/l
Bromodichloromethane	ND - 0.4 ug/l
Methylene chloride	ND - 0.5 ug/l
Arsenic	<10 - 14 ug/l

ND = Not Detected

TCE was the only organic compound detected in significant concentration and therefore additional monitoring for TCE was conducted on the base water supply wells. The analytical results for the TCE analyses are presented in Table 3.7. As indicated above, Well Nos. 1, 2, 3, and 4 are the major wells used for water supply and Well Nos. 3 and 4 are only used during periods of extreme water demand.

Since installation of test wells in 1981, samples have been collected on a quarterly basis. The analytical TCE results are presented in Table 3.8.

TABLE 3.7
TCE LEVELS IN INSTALLATION WATER SUPPLY WELLS
(Parts Per Billion)

	Well Number									
	1	2	3	4	5	6	7	8	9	11
Well depth (ft)	305	320	290	290	120	160	260	300	300	90
Sampling Date										
10 Mar 1978	<1.5	<1.5		3.3					<1.5	
28 Mar 1978	<1.5	<1.5	3.6	1.6					<1.5	
28 Jun 1978	<1.5	<1.5	4.7	2.3				<1.5		<1.5
25 Feb 1980		<1.0	4.1	1.6	<1.0	<1.0	<1.0	<1.0		<1.0
18 Mar 1980	<.5	<.5	.7	5.7	<.5	<.5	<.5	<.5		<.5
23 Oct 1980			16.0	7.0						
23 Oct 1980	Trace	1.2	11.9	6.6	Trace	Trace	Trace	Trace		Trace
12 Jan 1981	<.5	4.3	30.5	6.4	<.5	<.5	<.5	<.5		
09 Jun 1981	Trace	8.6	16.1	7.6	ND	ND				
13 Jul 1981	0	7.3	9.9	4.0	ND	ND				
10 Aug 1981	Trace	11.9	46.4	8.6	ND	ND	Trace	ND		ND
31 Aug 1981		22.1	22.1	7.6						
15 Sep 1981	Trace	9.2	18.1	5.2						
13 Oct 1981	Trace	8.5	14.3	6.7						
10 Nov 1981	Trace	7.5	11.9	5.1						
23 Nov 1981			10.1							
07 Dec 1981	6.4	7.2	3.8	2.4						
14 Dec 1981			5.4					4.0		
19 Jan 1982	Trace	6.7	7.8	3.6						
08 Feb 1982	0.2	8.5	12.4	5.1	ND	ND	ND	ND		ND
17 Mar 1981	Trace	6.2	7.3	2.5						
13 Apr 1982	Trace	6.7	1.8	4.1						
18 May 1982	Trace	4.3	Inop.	3.5						
09 Jun 1982	Trace	7.7	Inop.	5.8						
20 Jul 1982	Trace	5.0	Inop.	7.0						
14 Sep 1982	Trace	4.8	Inop.	5.8						
13 Oct 1982	Trace	4.0	Inop.	8.2						
17 Nov 1982	Trace	5.2	Inop.	4.0						
12 Jan 1983	Trace	3.7	Inop.	6.4						
09 Feb 1983	ND	7.8	Inop.	9.1	ND	ND	ND			ND
22 Mar 1983	Trace	7.2	Inop.	10.8						
04 Apr 1983	Trace	2.8	Inop.	9.5						
18 May 1983	Trace	12.7	30.1	17.0	ND	ND	ND	ND	0.2	ND
13 Jun 1983	0.3	12.8	ND	15.4						

ND = Not detected.
Inop. = Inoperative

Source: Castle AFB Installation Document.

TABLE 3.8
TCE LEVELS IN INSTALLATION TEST WELLS
(Parts Per Billion (ppb)

	Well Number							
	12	13	14	15	16	17	18	19*
Well depth (ft)	97	90	92	82	102	100	89	
Sampling Date								
23 Nov 1981	Trace	21.5	28.0	27.2	58.7	7.6	2.4	
14 Dec 1981	--	18.9	23.3	18.7	57.4	7.9	1.6	
08 Feb 1982	ND	27.0	49.0	18.0	120	7.7	3.0	
18 May 1982	Trace	22.0	31.0	Inop.	55	5.8	3.3	
18 Aug 1982	ND	18.3	32.8	Inop.	36.7	6.1	4.1	
17 Nov 1982	ND	18.5	17.4	Inop.	60	7.7	4.3	
09 Feb 1983	ND	28.9	96.2	16.6	35.6	13.0	5.8	
18 May 1983	ND	33.9	68.0	18.5	136.0	19.4	5.8	

ND = Not detected.
Inop. = Inoperative.
-- = No data.
* - No information available on Well No. 19.

Source: Castle AFB Installation Documents.

Off-Base wells have been sampled by the Air Force and the State Department of Health Services. The results of these samplings are shown in Table 3.9.

Using the ground water quality data on TCE from the 18 May 1983 sampling event from installed test wells, and plotting those data, nisoconcentration contours were mapped. Figure 3.13 shows a "plume" delineating equal concentrations of TCE in the ground water over a limited area. It must be recognized that this figure was prepared based on seven data points. The actual configuration of the TCE isoconcentration contours may differ from that depicted on Figure 3.13. In addition, data from the base water supply wells were not included as these wells penetrate into the intermediate confined aquifer.

Inspection of Figure 3.13 shows that the axis of the "plume" is not parallel with the ground water flow direction. A possible explanation could be a localized cone of depression induced by pumpage from the base wells and vicinity M.I.D. wells. The pumpage plus a hydraulic connection between the two aquifers via well annulus areas could provide sufficient inducement of ground water flow.

Surface Water Quality

There are no natural surface water bodies on the base. Drainage ditches convey runoff to the southern part of the base where it is only discharged to Canal Creek during major storm events.

Surface waters are sampled at the base runoff discharge point as well as upstream and downstream from that discharge point (see Figure 3.14). The two off-base locations are Livingston Canal at the intersection of Fox and Bellevue and at the Avenue Two bridge crossing of Canal Creek. Parameters sampled quarterly are chemical oxygen demand (COD), oil and grease, lead, and surfactants. Table 3.10 shows the ranges in concentrations from samples collected during 1981 and 1982. Examination of the surface water analytical data in the vicinity of the base indicates that no degradation of the water quality has occurred as a result of the surface runoff from the base.

TABLE 3.9
TCE LEVELS IN PRIVATE WELLS ADJACENT TO CASTLE AFB
(Parts Per Billion)

(Refer to Figure 3.11)

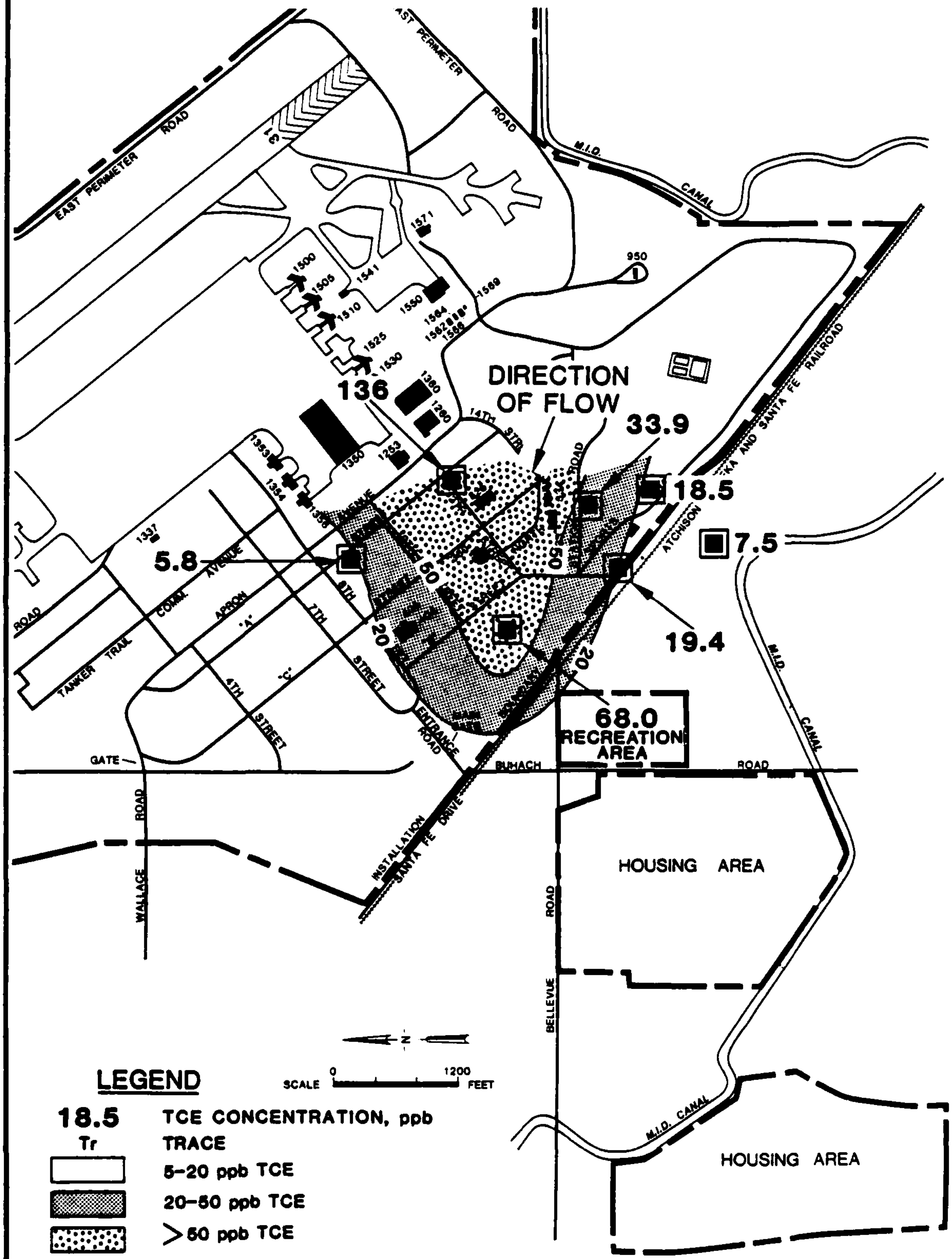
Well Identification	Well Depth (feet)	Sampling Dates											
		2/07/80	3/13/80[1]	10/23/80	10/23/80[1]	1/12/81	12/14/81	2/08/82	2/10/82[1]	2/10/82	2/17/82	12/09/82	5/18/83
CMHP1				3.0	3.1	2.6		--				--	
CMHP2				3.2	3.1	2.8		1.0		Tr<1.0		4.8	
CMHP3				Tr<1.0	<0.5	--		--				<1.0	
Stoltz/Roberts 4841 Bellevue	85	2.7	8.7	6.1	6.5	8.2	3.5	2.1	4.8	2.1		6.9	
Magar 4781 Santa Fe	103	Tr<1.0	<0.5	15.4	19.0	22.6	10.0	8.9	20.0	8.9		24.0	7.5
Luthey 4531 Santa Fe	114	ND<1.0	<0.5										
Sexauer 4450 Santa Fe	100		<0.5										
Porath 4260 N. Gurr Rd.				Tr<1.0	<0.5								
Vaughn 4740 Buhach				ND<0.5	<0.5				1.9	1.0			
Fragulia 4246 Avenue Two				Tr<1.0	<0.5								
68 Castle Dr.						ND<0.5			194/17		0.11		
4614 Buhach											0.11		
5022 Broadway											0.10		

[1] Analyzed by California Department of Health Services.

CMHP = Castle Mobile Home Park
Source: Castle AFB Installation Documents

CASTLE AFB

TCE ISOCONCENTRATION CONTOURS MAY 1983



LEGEND

18.5 TCE CONCENTRATION, ppb

Tr TRACE

5-20 ppb TCE

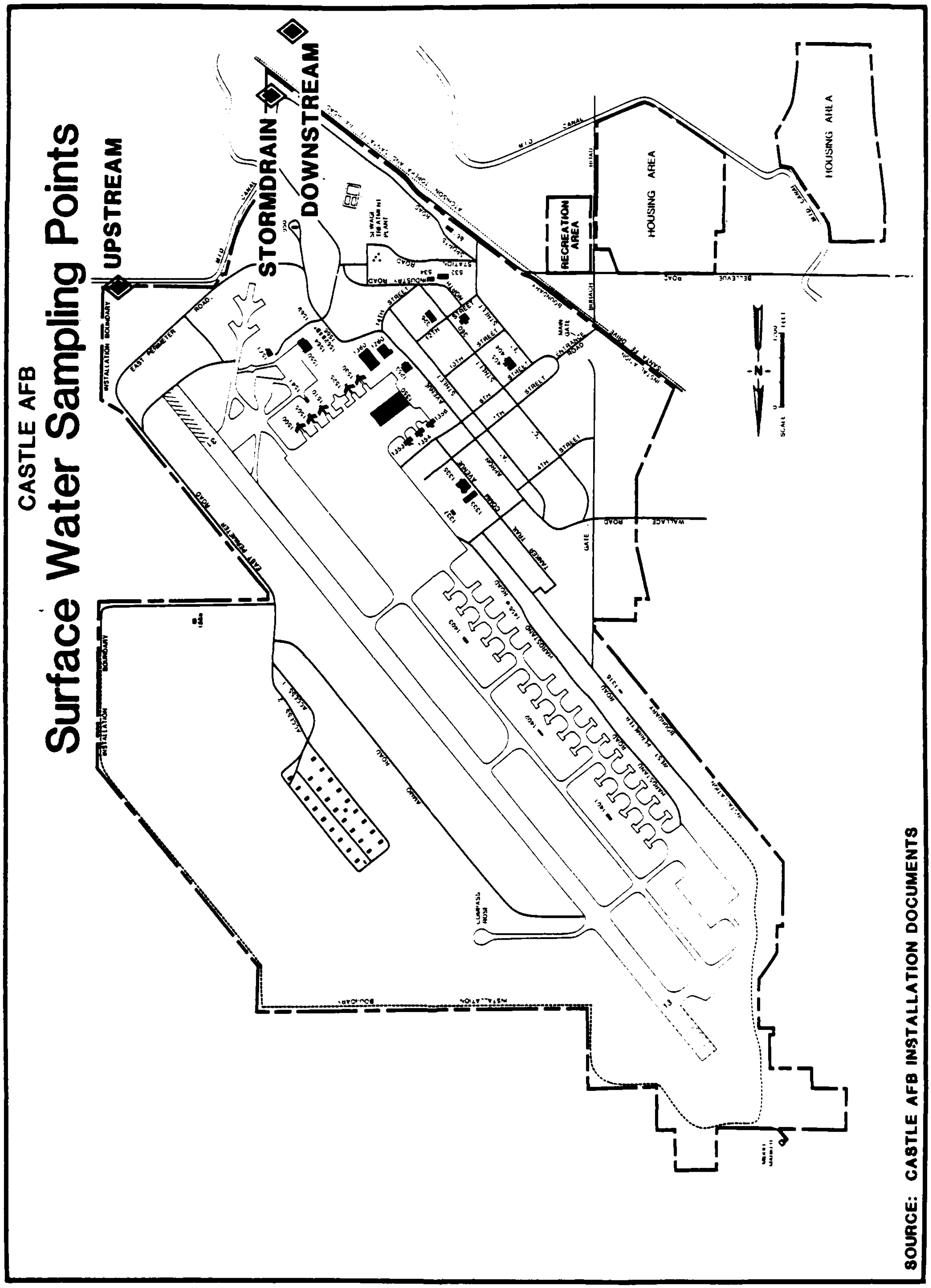
20-50 ppb TCE

>50 ppb TCE

NOTE: THE ISOCONCENTRATION CONTOURS REPRESENT THE TCE CONCENTRATIONS DETECTED IN THE SHALLOW UNCONFINED AQUIFER

SOURCE: CASTLE AFB INSTALLATION DOCUMENTS

FIGURE 3.14



SOURCE: CASTLE AFB INSTALLATION DOCUMENTS

TABLE 3.10
SURFACE WATER QUALITY SAMPLING DATA

		Upstream	Stormdrain	Downstream
February 1981	COD	48 mg/L	35 mg/L	30 mg/L
	Oil & Grease	<.3 mg/L	<.3 mg/L	<.3 mg/L
	Lead	No Sample	<50 ug/L	<50 ug/L
	Surfactants	0.2 mg/L	0.3 mg/L	0.8 mg/L
May 1981	COD	<10 mg/L	50 mg/L	<10 mg/L
	Oil & Grease	0.4 mg/L	5 mg/L	0.4 mg/L
	Lead	<50 ug/L	<50 ug/L	No Sample
	Surfactants	<.1 mg/L	0.4 mg/L	<.1 mg/L
August 1981	COD	<10 mg/L	27 mg/L	10 mg/L
	Oil & Grease	0.3 mg/L	<.3 mg/L	<.3 mg/L
	Lead	<50 ug/L	<50 ug/L	<50 ug/L
	Surfactants	<.1 mg/L	0.1 mg/L	<.1 mg/L
November 1981	COD	26 mg/L	14 mg/L	19 mg/L
	Oil & Grease	0.4 mg/L	0.4 mg/L	2.6 mg/L
	Lead	<50 ug/L	<50 ug/L	<50 ug/L
	Surfactants	0.1 mg/L	0.1 mg/L	<.1 mg/L
December 1982	COD		46 mg/L	69 mg/L
	Oil & Grease	4.5 mg/L	1.2 mg/L	3.9 mg/L

Note: See Figure 3.14 for location of sampling points.

Source: Castle AFB Records

BIOTIC COMMUNITIES

The natural vegetation of the Merced area consists primarily of salt-tolerant plants, since the soils generally contain soluble salts and alkalis. The principal grass is saltgrass (*Distichlis spicata*). Trees such as the white oak, Fremont cottonwood, Oregon ash, Boxelder, and several willows are found along surface water drainage areas (SCS 1980).

The California Natural Diversity Base reports a Northern Hard Pan Vernal Pool within one mile of the base, and the *Monardella leucocephala*, on the California Native Plant Society List 1, within 5 miles of the base.

Wildlife in the area consists almost exclusively of jack rabbits, rodents, and birds, including ducks and pheasants. There are no endangered species on the base (California Department of Fish and Game, 1983).

ENVIRONMENTAL SETTING SUMMARY

The environmental setting data for Castle AFB indicate the following data are important when evaluating past hazardous waste disposal practices.

1. The mean annual precipitation is 12.23 inches; the net precipitation is -41 inches and the one-year 24-hour rainfall event is 1.25 inches. These data indicate a net precipitation deficiency and very low potential for storms to create surface runoff. These factors are important in limiting natural surface-water infiltration which might promote leachate generation.
2. Man-made infiltration methods (agricultural irrigation) operating on and near the base increase the rate of infiltration thereby potentially increasing the rate of leachate generation from waste sites on the base.
3. Dewatering and irrigation wells used in conjunction with agricultural processes are operating near the base which may impact the ground-water gradients within the shallow unconfined aquifer on base.

4. The soils on base are typically sand, silty sand, and sandy silt and are generally well drained. A hardpan layer generally less than five feet below ground, is discontinuous over the base and may restrict the vertical movement of shallow ground water. Where vertical movement is restricted, the ground water forms perched water tables. The permanent water table is generally encountered at 30 feet below ground within sand and gravel zones comprising the shallow unconfined aquifer. These data indicate a moderately deep permanent water table with highly permeable zones underlying the base, but a perched water table above discontinuous hardpan. These factors are important in the generation of leachate and in the determination of possible contaminant flowpaths away from a waste site.
5. Clay zones as much as 100 feet thick beneath the unconfined shallow aquifer may restrict the vertical movement of ground water. This fact indicates that possible contaminant movement may be restricted to horizontal movements within the unconfined shallow aquifer. This aquifer is extensively used off base as a water supply source.
6. The intermediate confined aquifer lies beneath the clay zone and is used as a water supply source for the base.
7. The lower confined aquifer lies beneath additional clay zones and is a primary source of drinking water for users downgradient of the base.
8. The base and vicinity are recharge zones for the unconfined shallow aquifer and potential recharge areas for the intermediate and lower confined aquifers. These data indicate a potential for downward movement of ground water and possible contaminants.
9. The ground-water quality of the unconfined shallow aquifer and the intermediate confined aquifer have been impacted by TCE both on base and off base. These data document ground-water contamination, but the source(s) have not been identified.

10. Examination of the surface water analytical data in the vicinity of the base indicates that no degradation of the water quality has occurred as a result of the surface runoff from the base.
11. There are no threatened or endangered species on Castle AFB.

SECTION 4

FINDINGS

To assess hazardous waste management at Castle Air Force Base, past activities of waste generation and disposal methods were reviewed. This chapter summarizes the hazardous waste generated by activity; describes waste disposal methods; identifies the disposal sites located on the base; and evaluates the potential for environmental contamination.

PAST SHOP AND BASE ACTIVITY REVIEW

To identify past activities that resulted in generation and disposal of hazardous waste, a review was conducted of current and past waste generation and disposal methods. This activity consisted of a review of files and records, interviews with current and former base employees, and site inspections.

The source of most hazardous wastes on Castle AFB can be associated with one of the following activities:

- Industrial operations
- Fire protection training
- Pesticide utilization
- Fuels management

The following discussion addresses only those wastes generated on Castle AFB which are either hazardous or potentially hazardous. In this discussion, a substance is defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), or the California Administrative Code, Title 22. A potentially hazardous waste is one which is suspected of being hazardous, although insufficient data are available to fully characterize the waste material.

INDUSTRIAL OPERATIONS

Industrial operations at Castle AFB consist primarily of aircraft and vehicle maintenance and repair activities. These and other mission support operations generate potentially hazardous materials at a number of industrial shops. The Bioenvironmental Engineering (BEE) Office provided a listing of industrial shops which was used as a basis for evaluating past waste generation and hazardous material disposal practices. The BEE individual shop files were also examined for information on hazardous material usage, and hazardous waste generation and disposal practices. From this information, a master list of industrial shops was prepared showing building locations, hazardous materials handlers, hazardous waste generators, and typical treatment, storage, and disposal methods. The list appears as Appendix D.

Those shops which were determined to be generators of hazardous wastes and pose a potential for ground-water or surface water contamination were selected for further investigation and evaluation. During the site visit, interviews were conducted with personnel from many of these industrial shops, including the shops that generate the largest amounts of hazardous wastes. Additional shops generating lesser amounts of hazardous wastes were contacted by telephone. Shop interviews focused on hazardous waste materials, waste quantities, and disposal methods. Disposal time lines were prepared for each major hazardous waste from information provided by shop personnel and others familiar with the shop's operations and activities.

Table 4.1 summarizes the information obtained from the detailed shop review including information on present and past shop locations, identification of hazardous wastes, waste quantities, and disposal methods. Disposal time lines are also shown for major wastes. Table 4.1 does not include the shops which generate insignificant quantities of hazardous wastes.

A general review of the waste disposal practices which occurred at Castle AFB is discussed below.

1940's to Mid-1970's

During the early period of the base operations (1940's through mid-1970's) the majority of the waste oils, fuels and solvents were reported to have been disposed of in pits throughout the base. A pit located adjacent to the first fire protection training area (FPTA No. 1) had been used from the 1940's through the mid-1970's for burning waste oils, fuels and solvents. Other pits located in the vicinity of whichever landfill was active at the time, received oils and chemical wastes. No burning was conducted at any of the landfill pits. Some of the chemical wastes were reported to have been discharged to the sanitary and storm sewers or allowed to runoff on to surface soils directly adjacent to specific maintenance facilities. During the latter portion of this period (early to mid-1970's) some contaminated petroleum wastes were contracted for off-base disposal.

Mid-1970's to Present

During the mid-1970's, waste oils and fuels were collected by the various organizations generating these wastes and contracts were arranged for off-base disposal of the waste petroleum products. Many of the solvents and other chemical wastes were either combined with the waste oils and fuels or discharged to the sanitary, industrial or storm sewer systems. Some wastes were still allowed to runoff into areas adjacent to the specific facilities. Beginning in the early 1980's contaminated fuel was once again burned during fire protection training exercises. Solvents and other hazardous chemicals were collected at designated storage areas and contracts for disposal were occasionally arranged. A large quantity of hazardous waste accumulated over a two-year period is presently being stored in an area designated for hazardous waste storage. Arrangements are currently underway for contracting the removal of these wastes.

Waste Discharge Areas (DA)

Several of the industrial maintenance facilities at Castle AFB were known to have discharged the wastes generated at the facility onto the surface soils in areas immediately adjacent to the specific facility. Eight discharge areas were identified on the base. These areas were depicted on Figure 4.1 and discussed in the following paragraphs.

TABLE 4.1
INDUSTRIAL OPERATIONS (Shops)
Waste Management

SHOP NAME	LOCATION (BLDG. NO.) PRESENT	LOCATION (BLDG. NO.) PAST	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1940 1950 1960 1970 1980
93 FIELD MAINTENANCE SQUADRON					
FUEL SYSTEMS REPAIR	flight-line		CLEANER SOLUTION	110 GALS./YR.	47 FPTA/CDP[(a)] - - - (b) 82 HAZARDOUS WASTE STORAGE AREA
			CONTAMINATED FUEL	Unknown	FPTA/CDP[(a)] - - - (b) 80 BURNED IN FIRE PROTECTION TRAINING AREA
JET ENGINE INTERMEDIATE MAINTENANCE	1260		PD-680	40 GALS/MO.	INDUSTRIAL SEWER SYSTEM
			TRICHLOROETHANE (past: Trichloroethylene)	5 GALS./MO.	FPTA/CDP[(a)] - - - 76
			CARBON REMOVER	50 GALS./MO.	FPTA/CDP[(a)] - - - 75 (b) 82 HAZARDOUS WASTE STORAGE AREA
			CONTAMINATED JP-4	80 GALS./MO.	FPTA/CDP[(a)] - - - 75 (b) 80 BURNED FIRE PROTECTION TRAINING AREA
			HYDRAULIC FLUID	10 GALS./MO.	FPTA/CDP[(a)] - - - CONTRACT DISPOSAL
			LUBE OIL	4 GALS./MO.	FPTA/CDP[(a)] - - - CONTRACT DISPOSAL
PNEUDRAULICS	1350		HYDRAULIC FLUID	30 GALS./MO.	FPTA/CDP[(a)] - - - CONTRACT DISPOSAL
			PD-680	100 GALS./MO.	FPTA/CDP[(a)] - - - INDUSTRIAL SEWER AND CONTRACT REMOVAL
ELECTRIC	1350		USED OIL	10 GALS./MO.	FPTA/CDP[(a)] - - - CONTRACT DISPOSAL

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

(a) FIRE PROTECTION TRAINING AREA/CHEMICAL DISPOSAL PIT - MOST WASTE HAULED TO THESE AREAS; SOME WASTES DISCHARGED TO SANITARY, INDUSTRIAL OR STORM SEWERS.

(b) DISPOSAL OFF-BASE BY CONTRACTOR, DISCHARGED TO SANITARY, INDUSTRIAL OR STORM SEWERS (BOTH METHODS OF DISPOSAL WERE UTILIZED DURING THIS TIME FRAME).

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.) PRESENT	LOCATION (BLDG. NO.) PAST	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1940 1950 1960 1970 1980
93 FIELD MAINTENANCE SQUADRON (cont'd)					
ENVIRONMENTAL SYSTEMS	1350		TRICHLOROFLOROETHANE	5 GALS./YR.	DISPOSAL IN SEWER SYSTEM AND CONTRACT DISPOSAL; HAZARDOUS WASTE STORAGE AREA 82
AIRCRAFT REPAIR	1350		PD-680	25 GALS./MO.	FPTA/CDP[a] (b)
			USED OILS	10 GALS./MO.	FPTA/CDP[a] CONTRACT DISPOSAL
NDI	1532		PENETRANT	10 GALS./MO.	FPTA/CDP[a] (b) HAZARDOUS WASTE STORGAE AREA 82
			EMULSIFIERS	10 GALS./MO.	FPTA/CDP[a] (b) HAZARDOUS WASTE STORAGE AREA 82
			TRICHLOROETHANE	25 GALS./MO.	FPTA/CDP[a] 75 (b) HAZARDOUS WASTE STORAGE AREA 82
AGE	1325		PD-680	10 GALS./MO.	TO WASH RACK TO SANITARY SEWER
			HYDRAULIC FLUID	30 GALS./MO.	FPTA/CDP[a] 72 CONTRACT DISPOSAL
			USED OIL	25 GALS./MO.	FPTA/CDP[a] CONTRACT DISPOSAL
CORROSION CONTROL	1253		MEK	50 GALS./MO.	FPTA/CDP[a] 75 (b) CONTRACT REMOVAL
			PAINT STRIPPER	5 GALS./MO.	FPTA/CDP[a] (b) CONTRACT REMOVAL
			PAINT SLUDGE	165 GALS./MO.	DISPOSAL IN PITS AND LANDFILLS; CONTRACT REMOVAL
METALS PROCESSING	1253		USED OIL	10 GALS./MO.	FPTA/CDP[a] CONTRACT DISPOSAL

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

(a) FIRE PROTECTION TRAINING AREA/CHEMICAL DISPOSAL PIT - MOST WASTE HAULED TO THESE AREAS; SOME WASTES DISCHARGED TO SANITARY, INDUSTRIAL OR STORM SEWERS.

(b) DISPOSAL OFF-BASE BY CONTRACTOR, DISCHARGED TO SANITARY, INDUSTRIAL OR STORM SEWERS (BOTH METHODS OF DISPOSAL WERE UTILIZED DURING THIS TIME FRAME).

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.) PRESENT	LOCATION (BLDG. NO.) PAST	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1940–1980)
93rd FIELD MAINTENANCE SQUADRON (cont'd)					
ENGINE TEST CELL	949		CONTAMINATED JP-4	50 GALS./MO.	COLLECTED FOR DISPOSAL BY CONTRACT; RUNOFF INTO ADJACENT SURFACE SOILS
			PD-680	50 GALS./MO.	COLLECTED FOR DISPOSAL BY CONTRACT; RUNOFF INTO ADJACENT SURFACE SOILS; 83
ELECTROPLATING SHOP		52	CYANIDE AND CADMIUM SOLUTION	Uncertain	BURIED IN LANDFILL; 60
93rd AVIONICS MAINTENANCE SQUADRON					
TRAINER MAINTENANCE	1404		USED OIL	50 GALS./MO.	45 FPTA/CDP[a]; CONTRACT DISPOSAL
			PD-680	15 GALS./MO.	60 FPTA/CDP[a]; 72 CONTRACT DISPOSAL
SCRAM A/C CHECK-OUT	1319		MEK	<55 GALS./YR.	FPTA/CDP[a]; 75 (b); 80 CONTRACT REMOVAL
93rd MUNITIONS MAINTENANCE SQUADRON					
DEFENSIVE FIRE CONTROL	1335		WASTE SOLVENTS (Trichloroethane, Methylchloroform; past: Trichloroethylene)	110 GALS./MO.	FPTA/CDP[a]; 75 (b); 87 HAZARDOUS WASTE STORAGE AREA
			LUBE OIL	55 GALS./YR.	FPTA/CDP[a]; 72 REMOVED BY CONTRACTOR
			PD-680	110 GALS./YR.	FPTA/CDP[a]; 75 (b); 82 HAZARDOUS WASTE STORAGE AREA
PMEL	1532		MERCURY	5 LBS./MO.	TURNED INTO DPDO

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

(a) FIRE PROTECTION TRAINING AREA/CHEMICAL DISPOSAL PIT . MOST WASTE HAULED TO THESE AREAS; SOME WASTES DISCHARGED TO SANITARY, INDUSTRIAL OR STORM SEWERS.

(b) DISPOSAL OFF-BASE BY CONTRACTOR, DISCHARGED TO SANITARY, INDUSTRIAL OF STORM SEWERS (BOTH METHODS OF DISPOSAL WERE UTILIZED DURING THIS TIME FRAME).

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.) PRESENT	LOCATION (BLDG. NO.) PAST	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1940 – 1950 – 1960 – 1970 – 1980)
93rd AVIONICS MAINTENCE SQUADRON					
AIR CREW TRAINING DEVICES	175		HYDRAULIC FLUID	250 GALS./YR.	DISPOSED BY CONTRACTOR
PHOTO LAB	1335		FIXER SOLUTION	5 GALS./MO.	SILVER RECOVERY TO SANITARY SEWER
ELECTRONIC COUNTER MEASURES	1335		WASTE SOLVENTS AND OILS	10 GALS./MO.	FPTA/CDP[a]; DISPOSED BY CONTRACTOR
93rd CIVIL ENGINEERING SQUADRON					
HEATING SECTION	541		ASBESTOS INSULATION	5 LBS./MO.	DOUBLE BAGGED DISPOSED OF IN SANITARY LANDFILL
ENTOMOLOGY	917		HERBICIDE AND INSECTICIDE CONTAINERS	< 10/MO.	TO LANDFILL; 79 TRIPLE RINSED TO DUMPSTER; 85 STORED IN HAZARDOUS WASTE STORGAE AREA
			RINSEATE	UNKNOWN	DRAINED TO ADJACENT SURFACE AREAS; DRAINED TO EVAPORATION PIT
LIQUID FUELS MAINTENANCE	545		SLUDGE FROM FUEL STORAGE TANKS	180 GALS./YR.	DISPOSED IN LANDFILL PITS; 60 WEATHERED ON SURFACE SOILS; BURNED IN FIRE PROTECTION TRAINING AREA
			FUEL FILTERS	30 ELEMENTS/MO.	TO LANDFILL; WEATHERED PRIOR TO LANDFILL DISPOSAL; STORED IN HAZARDOUS WASTE STORAGE AREA
EXTERIOR ELECTRICS	851		PCB TRANSFORMERS AND CAPACITORS	0 - 4/YR.	DISPOSED THROUGH SALVAGE; 78 STORED IN PCB STORAGE AREA DISPOSAL FOR CONTRACT

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

(a) FIRE PROTECTION TRAINING AREA/CHEMICAL DISPOSAL PIT - MOST WASTE HAULED TO THESE AREAS; SOME WASTES DISCHARGED TO SANITARY, INDUSTRIAL OR STORM SEWERS.

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.) PRESENT	LOCATION (BLDG. NO.) PAST	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1940 – 1950 – 1960 – 1970 – 1980)
93rd CIVIL ENGINEERING SQUADRON (cont'd)					
POWER PRODUCTION	951		PD-680	5 GALS./MO.	TO POL U/G STORAGE TANK FOR CONTRACT DISPOSAL
			SULFURIC ACID	2 GALS./MO.	64 NEUTRALIZED TO SANITARY SEWER
			BATTERY CARCASSES	5 CASINGS/MO.	TO DISPOSAL PITS AND LANDFILLS; TO DPDO
EQUIPMENT MAINTENANCE	545		USED OIL	10 GALS./MO.	FPTA/CDP[(a)]; REMOVED BY CONTRACTOR
93rd SUPPLY SQUADRON					
LIQUID OXYGEN PLANT	1316		TRICHLOROETHYLENE	150 GALS./YR.	DISTRIBUTED OVER ADJACENT SURFACE AREA AND EVAPORATED
FUELS LAB	508		CONTAMINATED FUEL	Unknown	RECYCLED OR BURNED IN FIRE PROTECTION TRAINING AREA
			SPENT ACID AND SOLVENTS	1 GAL./MO.	TO SANITARY SEWER
FUELS MANAGEMENT	311		WASTE OILS	Unknown	RECEIVES CONTAMINATED WASTE OILS FROM SHOP AREAS AND TEMPORARILY STORES IN U/G STORAGE TANKS UNTIL CONTRACT DISPOSAL IS ARRANGED
93rd COMBAT SUPPORT GROUP					
AUTO HOPPY SHOP	551		WASTE OILS	275 GALS./YR.	FPTA/CDP[(a)]; 72 CONTRACT DISPOSAL
			SPENT SOLVENTS	10 GALS./MO.	FPTA/CDP[(a)]; 75 (b); CONTRACTOR SERVICE
PHOTO LAB AND GRAPHICS ARTS SECTION	84		FIXER SOLUTION	30 GALS./MO.	SILVER RECOVERY PRIOR TO DISCHARGE TO SANITARY SEWER

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

(a) FIRE PROTECTION TRAINING AREA/CHEMICAL DISPOSAL PIT - MOST WASTE HAULED TO THESE AREAS; SOME WASTES DISCHARGED TO SANITARY, INDUSTRIAL OR STORM SEWERS.

(b) DISPOSAL OFF-BASE BY CONTRACTOR, DISCHARGED TO SANITARY, INDUSTRIAL OF STORM SEWERS (BOTH METHODS OF DISPOSAL WERE UTILIZED DURING THIS TIME FRAME).

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.) PRESENT	LOCATION (BLDG. NO.) PAST	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1940 – 1950 – 1960 – 1970 – 1980)
93rd TRANSPORTATION SQUADRON					
VEHICLE MAINTENANCE	325		USED OILS	250 GALS./MO.	40 FPTA/CDP[a] 72 DISPOSED BY CONTRACTOR
			WASTE SOLVENTS	100 GALS./MO.	FPTA/CDP[a] (b) CONTRACTOR SERVICE 82
			PAINT AND PAINT THINNER	55 GALS./MO.	DISPOSAL IN LANDFILLS 60 DISPOSAL IN LANDFILLS; HAZARDOUS WASTE STORAGE AREA
BATTERY SHOP	325		SPENT ACID	10 GALS./MO.	NEUTRALIZED TO SANITARY SEWER
			BATTERIES	30 GALS./MO.	DISPOSED BY CONTRACTOR 79 TURNING TO SALVAGE
FIRE TRUCK MAINTENANCE	1344		USED OILS	30 GALS./MO.	FPTA/CDP[a] 72 DISPOSED BY CONTRACTOR
			WASTE SOLVENTS	<55 GALS./YR.	FPTA/CDP[a] (b) HAZARDOUS WASTE STORAGE AREA
REFUELING VEHICLE MAINTENANCE	59		USED OILS	50 GALS./MO.	DISPOSED BY CONTRACTOR
93rd OPERATIONS MAINTENANCE SQUADRON					
NON-POWERED AGE	1314		USED OIL	<5 GALS./MO.	47 FPTA/CDP[a] 72 DISPOSED BY CONTRACTOR
NON-POWERED AGE WASH RACK	hard-stand No. 6		CLEANING SOLVENTS DETERGENT	Unknown	60 DISPOSAL ON SURFACE SOILS ADJACENT TO WASHRACK; 79 USE OF CLEANING SOLVENTS DISCONTINUED

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

(a) FIRE PROTECTION TRAINING AREA/CHEMICAL DISPOSAL PIT - MOST WASTE HAULED TO THESE AREAS; SOME WASTES DISCHARGED TO SANITARY, INDUSTRIAL OR STORM SEWERS.

(b) DISPOSAL OFF-BASE BY CONTRACTOR, DISCHARGED TO SANITARY, INDUSTRIAL OR STORM SEWERS (BOTH METHODS OF DISPOSAL WERE UTILIZED DURING THIS TIME FRAME).

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.) PRESENT	LOCATION (BLDG. NO.) PAST	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1940, 1950, 1960, 1970, 1980)
93rd OPERATIONS MAINTENANCE SQUADRON (cont'd)					
AIRCRAFT WASH RACK	1521		PD-680	200 GALS./MO.	TO OIL WATER SEPARATOR DISCHARGED TO INDUSTRIAL SEWER OR SURFACE DRAINAGE. SEPARATED PD-680 REMOVED ON OCCASION BY CONTRACTOR
84th FIGHTER INTERCEPTER TRAINING SQUADRON					
CORROSION CONTROL	1541		WASTE PAINTS, PAINT THINNERS AND SOLVENTS	5 GALS./MO.	73 SLUDGE TO DUMPSTER, LIQUIDS TO; 78 TO HAZARDOUS WASTE STORAGE AREA
INSPECTION SECTION	1762		CONTAMINATED JP-4	1000 GALS./MO.	73 RECLAIMED OR DISPOSED BY CONTRACTOR; 79 (c)
PROPULSION	1260		CONTAMINATED JP-4	20 GALS./MO.	73 RECLAIMED OR DISPOSED BY CONTRACTOR; (c)
			USED OIL AND HYDRAULIC FLUID	30 GALS./MO.	73 DISPOSED BY CONTRACTOR
			PD-680	5 GALS./MO.	73 DISCHARGED TO INDUSTRIAL SEWER
			WASTE ACID	<3 GALS./MO.	73 DISCHARGED TO SANITARY SEWER
AGE	1562		WASTE OIL AND HYDRAULIC	70 GLAS./MO.	73 DISPOSED BY CONTRACTOR
			PD-680	165 GALS./MO.	73 DISPOSED BY CONTRACTOR OR DISCHARGED TO INDUSTRIAL SEWER
JET ENGINE TEST CELL	950		PD-680	20 GALS./MO.	73 RUNOFF INTO ADJACENT SURFACE SOILS; 82 DISPOSED BY CONTRACTOR
			CONTAMINATED JP-4	20 GALS./MO.	73 RUNOFF INTO ADJACENT SURFACE SOILS; DISPOSED BY CONTRACTOR

(c) BURNED IN FIRE PROTECTION TRAINING AREA

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

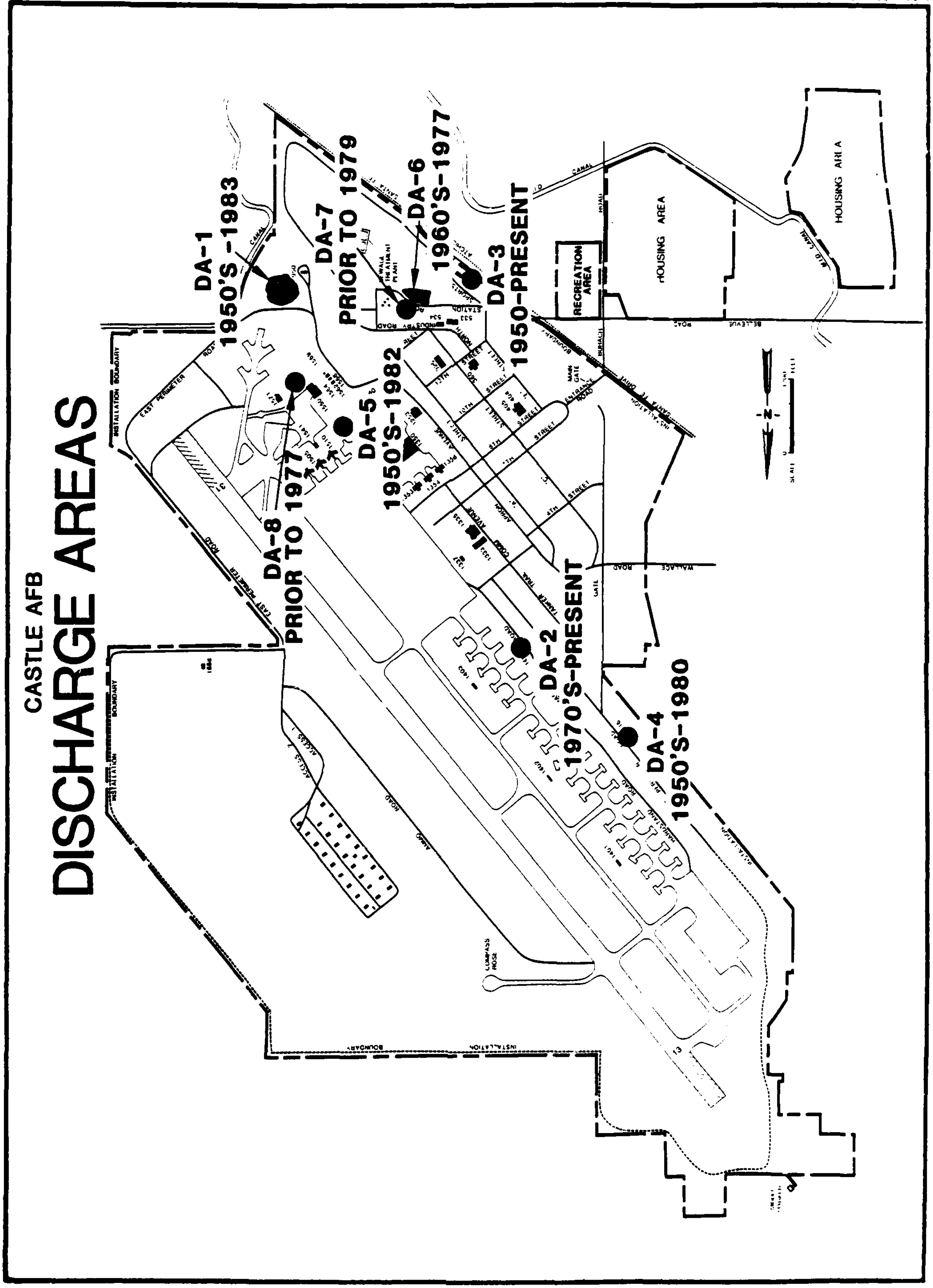
Waste Management

SHOP NAME	LOCATION (BLDG. NO.) PRESENT	LOCATION (BLDG. NO.) PAST	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1940 1950 1960 1970 1980
DET. 1 318 FIGHTER INTERCEPTER SQUADRON	1550/ 1560		CONTAMINATED FUEL	50 GALS./MO.	CONTRACTED FOR DISPOSAL OR BURNED IN FIRE PROTECTION TRAINING AREA (- - - - →)
USAF HOSPITAL					
DENTAL CLINIC X-RAY	1182		FIXER	10 GALS./MO.	SILVER RECOVERY PRIOR TO DISCHARGE TO SANITARY SEWER (- - - - →)
MEDICAL X-RAY	1182		FIXER	80 GALS./MO.	SILVER RECOVERY PRIOR TO DISCHARGE TO SANITARY SEWER (- - - - →)
SURGERY	1182		PATHOLOGICAL WASTES	Unknown	INCINERATED (- - - - →)

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL


CASTLE AFB
DISCHARGE AREAS
DA-1
1950'S -1983
DA-2
1970'S-PRESENT
DA-3
1950-PRESENT
DA-4
1950'S-1980
DA-5
1950'S-1982
DA-6
1960'S-1977
DA-7
PRIOR TO 1979
DA-8
PRIOR TO 1977
HOUSING AREA
RECREATION AREA
INSTALLATION BOUNDARY
EAST PERIMETER ROAD
COMPASS ROSE
WALLACE ROAD
BELLEVUE ROAD

Discharge Area No. 1 (DA-1)

Discharge Area No. 1 is located in a low lying area east of the Jet Engine Test Cell (Facility 953). The area has received the runoff from the test stands which have been used to test B-52 and KC-135 engines. The chemicals which have runoff into the discharge area include JP-4, PD-680 and soap. It has been estimated that a total of 1,500 gallons of JP-4, 3,500 gallons of PD-680 and 5,500 gallons of soap may have been discharged into the area since 1956. A very defined ditch extends from the test stand into the discharge area. A slight degree of surface discoloration was observed at the time of this study within the low lying discharge area. Presently the fuels and solvents are being cleaned off the test stand with absorbent material which is being stored for disposal in 55-gallon drums.

Discharge Area No. 2 (DA-2)

Discharge Area No. 2 is located behind Hardstand No. 6 along the flightline. The area is associated with the non-powered AGE washrack. Soap, solvents and oils rinsed from the washrack were contained in a captured concrete sump. Since its construction in the 1960's, whenever the sump would accumulate a substantial volume of liquids, a pump would be turned on to dissipitate the wastes over the surface soils behind the washrack. The soils in the area are void of vegetation and have a distinct oily coloration. The area is sloped toward a swale which runs into the surface drainage ditches on the base. Currently, the practice is still occurring although only soaps are being used in the cleaning operation.

Discharge Area No. 3 (DA-3)

Discharge Area No. 3 is located directly behind the civil engineering washrack (Building 850). The area receives the runoff generated from cleaning the equipment used by the Civil Engineering Squadron. Runoff from the washrack has included cleaning solvents, oils and possibly low concentrations of herbicides generated from rinsing the spray application equipment. The runoff from the washrack flows beneath the base boundary fence directly into a drainage ditch running parallel to the base boundary line. The washrack has likely been in use from the early 1950's to the present.

Discharge Area No. 4 (DA-4)

Discharge Area No. 4 is located adjacent to the liquid oxygen plant (LOX plant, Building 1316). From the early 1950's until 1980, filters used at the plant were routinely cleaned with trichloroethylene (TCE). The spent solvent was poured onto the adjacent soils in the area. It was estimated that 150 gallons per year of TCE were used in this process. Since TCE is very volatile, it is suspected that most of the solvent would have evaporated before it could percolate into the soils. Since 1980, the LOX plant has used disposable filters and hence the cleaning process is no longer performed.

Discharge Area No. 5 (DA-5)

Discharge Area No. 5 is located behind (south) of the main aircraft washracks. The washrack has been in use since the mid-1950's. Aircraft cleaning agents (soaps, PD-680) are rinsed into a drain which flows into an oil/water separator. The oil/water separator was designed to separate the solvents and oils for disposal and direct the contaminated water to the sewage treatment plant. In the past, there were frequent occasions when the drainage from the washrack had been diverted from the oil/water separator directly into a nearby surface drainage ditch (Refer to Appendix I Photographs). Solvents and oils separated in the oil/water separator have been pumped into an elevated storage tank adjacent to the washrack. Water separated in the storage tank was drawn off the bottom of the tank and allowed to flow into the drainage ditch. Currently, several thousand gallons of solvents are being stored in the storage tank awaiting proper disposal. There have been reports that other shop facilities on the base have used the aircraft washrack oil/water separator as a method of disposing PD-680 and other solvents. This implies that other solvent wastes may also have been discharged to storm drainage at Discharge Area No. 5.

Discharge Area No. 6 (DA-6)

Discharge Area No. 6 consists of a closed evaporation pond which was once a part of the industrial wastewater treatment plant. The old pond is located in the southern portion of the base near the sewage treatment plants (STP). It was in use from at least the early 1960's until 1977 when a spray irrigation program began. The pond received industrial wastes collected in the industrial sewer system. These

wastes consisted primarily of water contaminated with solvents and oils. Chemical analyses of the industrial wastewater tested in 1973, revealed high concentrations of COD (maximum 4350 mg/l) and surfactants (maximum 600 mg/l) and occasionally high concentrations of phenol (maximum 87 mg/l). The evaporation pond was unlined and had dimensions 2 feet deep by 1.5 acres. The pond was closed in 1977 and at that time was partially filled with soil and covered with grass. No clean-up efforts were undertaken when the pond was closed. The State of California did however request an analysis of soil samples from the area where the pond was located. Soil samples were analyzed from a soil boring which extended to a depth of ten feet. The analytical data are presented in Table 4.2. The State indicated in a transmittal letter to the base that the results of the analyses did not show any significant concentrations of contaminants.

Discharge Area No. 7 (DA-7)

Discharge Area No. 7 is located behind the Entomology Shop (Building 908). The site received rinse water from cleaning pesticide application equipment and empty cans from the early periods of base operation through 1979. In 1979, the base constructed a pit with dimensions approximately 10' x 10' by 5' deep. The pit is lined with a membrane liner. All rinse waters are currently directed to this pit and allowed to evaporate.

Discharge Area No. 8 (DA-8)

Discharge Area No. 8 is located adjacent to a drainage ditch southeast of Building 1550. Prior to 1976, TCE was used in an ultrasonic cleaner located in Building 1550. During the period that TCE was in use (TCE usage was confirmed from 1973 to 1976 although it was likely used prior to 1973), an overflow line from the cleaner would discharge TCE to a ditch behind Building 1550. Approximately five gallons per month of TCE was reported to have been discharged to the ditch during this period. The ditch was usually dry except during the wetter periods of the year.

Fire Protection Training Areas (FPTA)

The Fire Department has operated three fire protection training areas (FPTA) since the activation of Castle AFB. The following list

TABLE 4.2
ABANDONED INDUSTRIAL EFFLUENT LAGOON
SOIL ANALYSES

Depth	Cyanide (mg/g)	Trichloro-ethylene (mg/kg)	Tetachloro-ethylene (mg/kg)	Trihalomethanes (THM) (mg/kg)					Arsenic (ug/g)	Chromium (ug/g)	Lead (ug/g)	Mercury (ug/g)	Silver (ug/g)
				Chloroform	Bromo-dichloro-methane	Chloro-dibromo-methane	Bromoform	Total THM					
0' to -1'	ND<.0002	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	<100	<0.1	86.3	46.9	<0.01	1.9
-1' to -2'	ND<.0002	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	<100	<0.1	4.8	12.8	<0.01	2.9
-3' to -3.5'	ND<.0002	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	<100	<0.1	2.7	1.8	<0.01	<0.1
-5'	ND<.0002	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	<100	<0.1	1.2	1.4	<0.01	<0.1
-8'	ND<.0002	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	<100	<0.1	2.5	2.1	<0.01	<0.01
-9' to -10'	ND<.0002	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	ND<0.005	<100	<0.1	0.9	1.6	<0.01	<0.1

ND - None Detected, less than the detection limit

Source: Castle AFB records.

gives specific designations for these areas and identifies their approximate period of use. Figure 4.2 depicts their location.

Fire Protection Training Areas	Period of Operation
FPTA No. 1	1955-1975
FPTA No. 2	1962-1967
FPTA No. 3	1976-Present

Fire Protection Training Area No. 1

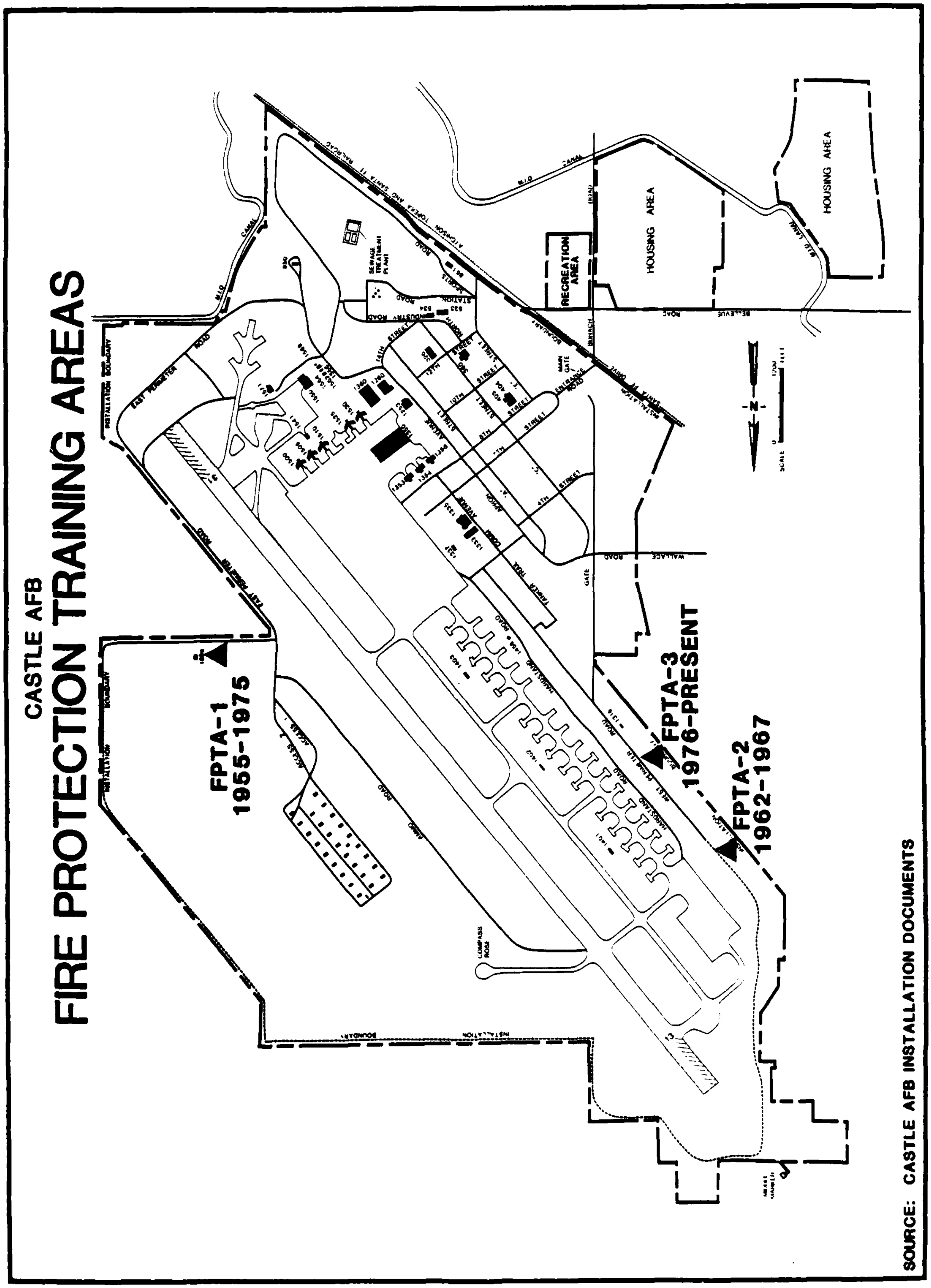
From approximately 1955 until 1975, the fire department conducted fire protection training exercises within a one acre area located in the eastern sector of the base east of the dog kennels (Fire Protection Training Area No. 1).

From 1955 to the mid 1970's, combustible waste chemicals were accumulated in a shallow two foot deep unlined pit in the FPTA. These chemicals were reported to have included waste oils, spent solvents, waste Avgas and jet fuel. Chemicals were accumulated weekly and burned in the unlined pit on Saturday or Sunday. Other chemicals were accumulated in 55-gallon drums and applied to a separate burn area which was adjacent to the burn pit. The burn area did not have a liner system nor was there any pre-application of water to prevent the percolation of the waste chemicals into the soil. The materials were applied directly to the soil and ignited. Toward the later period of usage in the 1970's, a 2,000-gallon tank was installed at the FPTA to accumulate some flammable chemicals. Aerial photos from 1972 indicate the chemical pit was still in use. No provision was made for collecting runoff from either the pit or burn area after a training exercise.

Fire Protection Training Area No. 2

From 1962 to 1967, an alternate fire protection training area (No. 2) was located on a one acre area located in the northern sector of the base west of Taxiway No. 11 (refer to Figure 4.7). The FPTA was used intermittently for training civilian firemen from nearby county and city fire departments in the use of foam extinguishers. The burn area was unlined and no provision was made for collecting runoff from the training exercise.

FIGURE 4.2



CASTLE AFB
FIRE PROTECTION TRAINING AREAS
FPTA-1
1955-1975
FPTA-3
1976-PRESENT
FPTA-2
1962-1967
HOUSING AREA
HOUSING AREA
RECREATION AREA
SEWAGE TREATMENT PLANT
SOURCE: CASTLE AFB INSTALLATION DOCUMENTS

Fire Protection Training Area No. 3

A new fire protection training area was constructed and put into operation in 1976 (FPTA No. 3). At that time, the use of FPTA No. 1 was discontinued. FPTA No. 3 is located in the northwestern sector of the base north of Building 1312. The pit is approximately 300 feet in diameter and is surrounded by a two-foot berm. A drain has been installed in the center of the FPTA to direct the runoff to a nearby underground oil/water separator. The oil/water separator is routinely inspected and pumped on an as-needed basis. Discharge from the oil/water separator is directed to an underground tile field. The new fire protection training area is operated in a different manner than FPTA No. 1. Only contaminated jet fuel is burned and the burn area is first saturated with water before the fuel is applied.

Pesticide Utilization

Pest management has been the responsibility of the host Civil Engineering Squadron since the base was constructed. Herbicide application responsibilities were transferred from Pavement and Grounds to the Entomology Shop in 1979. The pest management program has entailed routine and specific job-order chemical applications. Pesticides presently on hand at Castle AFB are listed in Appendix F, Table F.1.

The Entomology Shop has been located in Building 908 since the early period of base operations. Until 1979, all rinse water generated from the cleaning of pesticide application equipment and empty containers was discharged adjacent to the shop area (refer to discussion on DA-7). In 1979 the base constructed a membrane-lined pit to contain all rinse water and allow the water to evaporate.

Since 1979, all empty pesticide containers have been rinsed, crushed and stored in 55-gallon drums for disposal as hazardous wastes. Prior to 1979, the cans were disposed of with the general refuse.

No major pesticide spills were known to have occurred at the Entomology Shop or any other location on base.

Fuels Management

The fuels management system at Castle AFB consists of a central bulk fuel storage area which receives aircraft fuel via the Southern Pacific Pipeline. Fuel is delivered to the aircraft either by tanker truck or more often by the hydrant system located along the flightline

area. A listing of the locations of the fuel storage tanks and their products, capacities, date of construction and type of tank (i.e., underground or above ground) is provided in Appendix F, Table F.2. Fuels stored at Castle AFB include JP-4, JP-7, diesel, Mogas, Fuel Oil No. 2 and liquid propane. The base uses approximately 10 million gallons per month of JP-4 fuel.

The fuel offloading facilities, storage tanks, fuel transfer and hydrant system are maintained by the Civil Engineering Squadron's Liquid Fuels Maintenance Shop. The systems undergo routine inspection.

The fuel storage tanks have been cleaned on an as-needed basis. From the early years of the base operations through late 1960's fuel sludge generated from tank cleaning was either burned in fire training exercises or disposed of in chemical pits adjacent to the landfills. Starting in the late 1960's the fuel sludge was weathered on the surface of the active landfills. During the early 1980's, the contaminated fuel and water generated from the cleaning operation was taken to the oil/water separator located at the sewage treatment plant. Since 1983, contaminated fuels generated from the cleaning operations have been stored in the contaminated fuel storage tank and burned during fire training exercises.

Several practices were also used for disposing of the fuel filters generated throughout the operational history of the base. During the early 1950's when Avgas was used on the base; straw pack, used for filtering the fuel, was taken to the active landfills for disposal. In the late 1950's the fuel system was modified to use filters which were also disposed of in the landfills. Beginning sometime in the 1960's, fuel filters were weathered in a metal trough prior to disposal in the landfills. In 1983, a new procedure was implemented. The filters were placed in 55-gallon drums and stored in the hazardous waste storage area awaiting contract disposal.

Fuel Spills (FS)

Small fuel spills have occurred in several areas throughout the base. The spills are primarily attributed to fuel transfer and aircraft refueling operations. They typically occurred on paved areas and evaporated or were immediately cleaned-up. No significant environmental contamination is attributed to these spills.

There have been several larger fuel spills which have occurred at Castle AFB (Figure 4.3). From the early 1950's when the flightline hydrant system was first installed, until 1977; several large fuel spills occurred at the pumphouses along the flightline. These spills were attributed to a design problem in conjunction with operator negligence. It was reported that several large spills occurred at each of the three pumphouses (Buildings 1401, 1402, and 1403) during this period. The largest of these spills (Fuel Spill No. 1) occurred in November 1977 at Pumphouse No. 3 (Building 1403). It was estimated that 21,000 gallons of JP-4 were spilled. Approximately 1,000 gallons were recovered. The remainder of the fuels was washed to the storm drains which discharged to the drainage ditches on base. The drainage ditch was dry at the time of the spill. Therefore, all of the remaining fuel either evaporated or percolated into the soil. No fuel escaped the base boundaries.

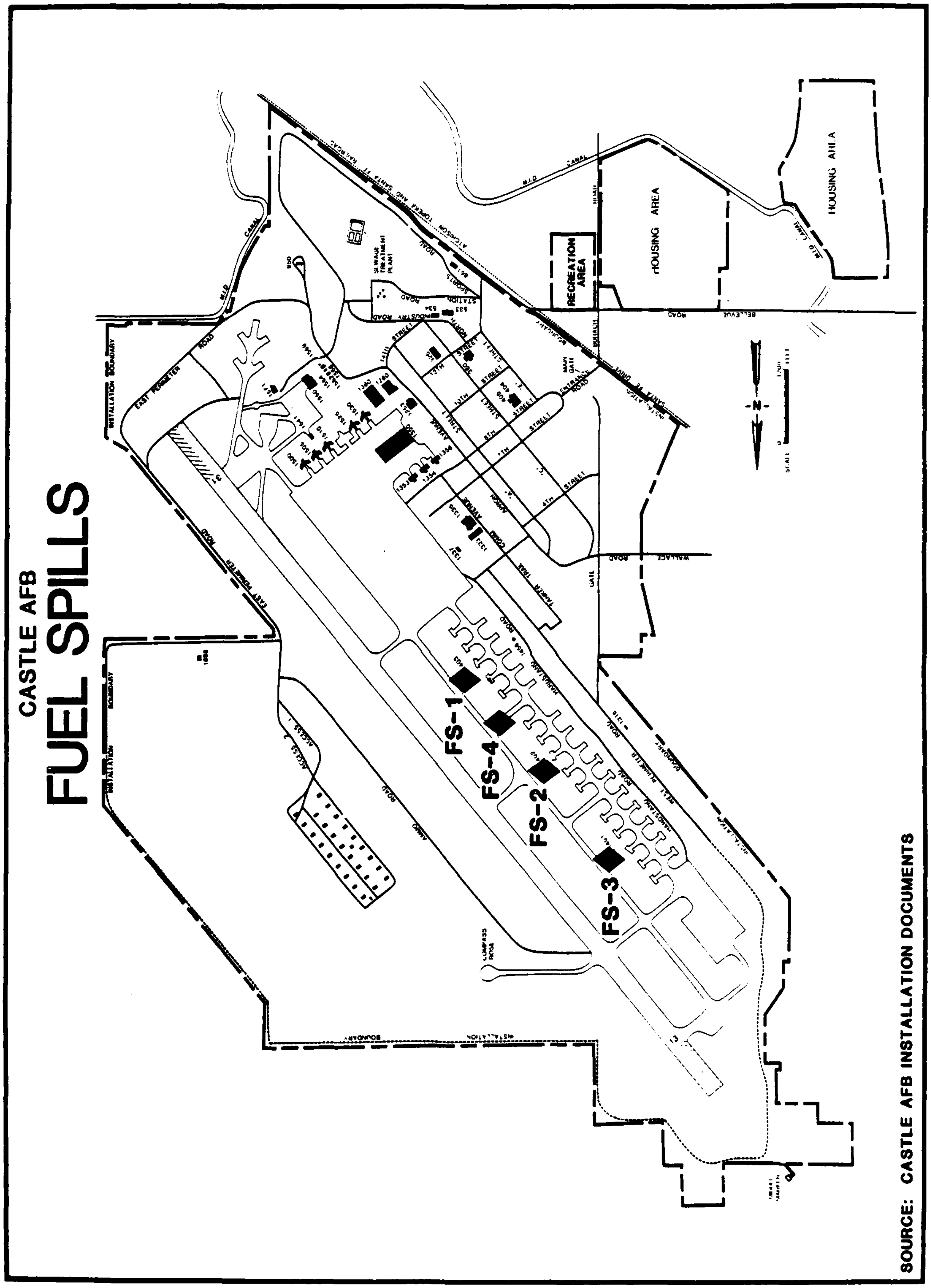
The piping in the pumphouses was redesigned in 1977. Since that time no spills have occurred at these areas.

Another spill associated with the hydrant system occurred sometime during the 1960's. The spill was attributed to a break in the fuel line beneath taxiway No. 9 (Fuel Spill No. 4). The leak was detected when the ground around the taxiway was observed to be saturated with fuel. The quantity of fuel lost is unknown. The pipeline was repaired immediately upon discovery of the leak.

Other large fuel spills (1,000 to 5,000 gallons) occurred in various maintenance facilities on the base. Most of these spills were washed into the storm drains which discharged to the drainage ditches. The fuel would then be trapped in the ditch and either allowed to evaporate or percolate into the soil.

Hazardous Waste Storage Areas (HWS)

Several areas around Castle AFB have been designated for the storage of hazardous waste. Many of the hazardous wastes such as oils and solvents have been temporarily stored in drums and bowsers at the point of generation. When a sufficient quantity of these wastes have been accumulated, they have been transferred to the bulk hazardous waste storage areas (Figure 4.4). Table 4.3 identifies these storage areas and the types of waste stored at each location.



SOURCE: CASTLE AFB INSTALLATION DOCUMENTS

FIGURE 4.4

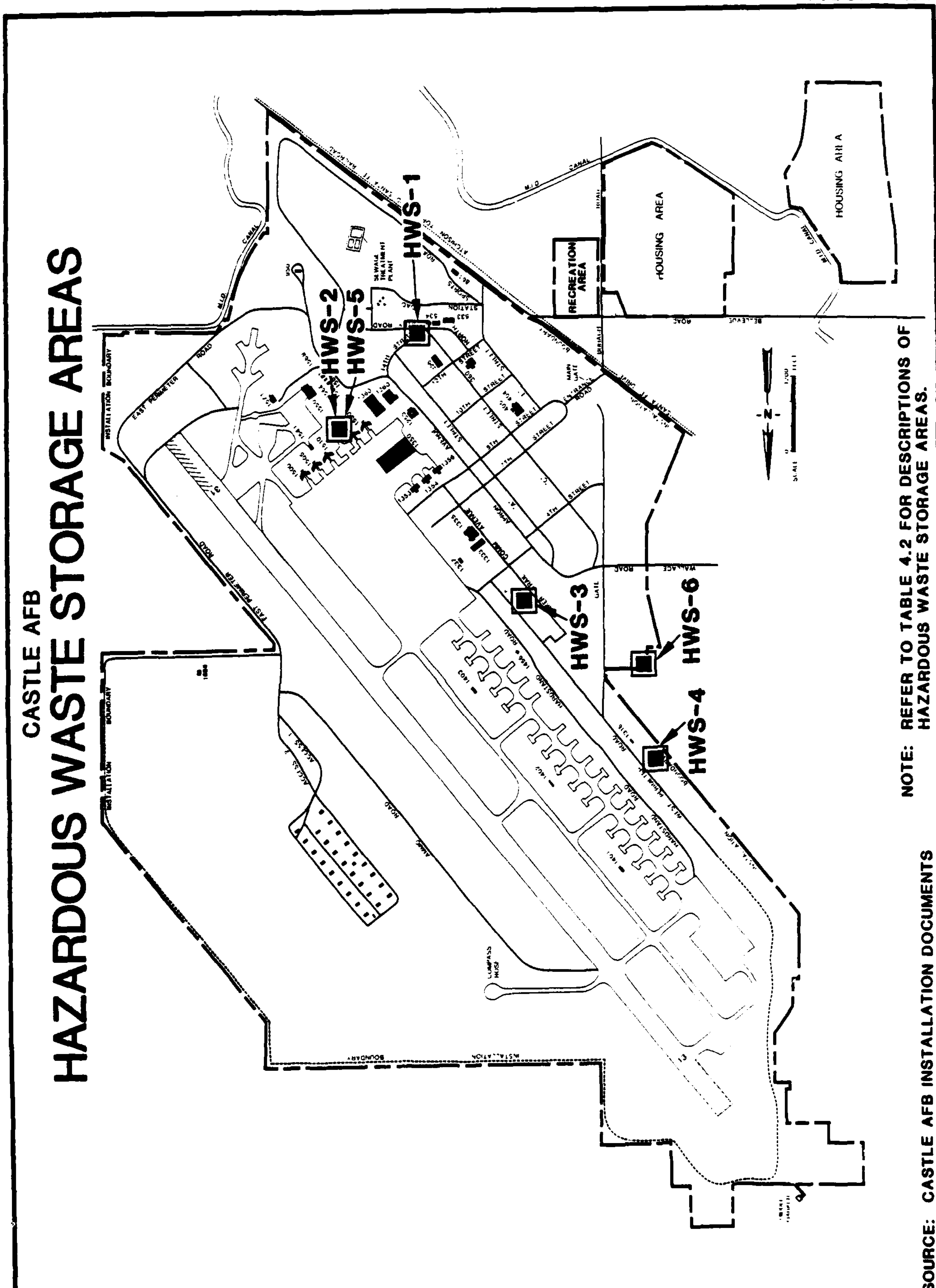

CASTLE AFB
HAZARDOUS WASTE STORAGE AREAS
HWS-1
HWS-2
HWS-5
HWS-3
HWS-6
HWS-4
HOUSING AREA
HOUSING AREA
RECREATION AREA
SEWAGE TREATMENT PLANT
INSTALLATION BOUNDARY
EAST PERIMETER ROAD
COMPASS ROSE
NOTE: REFER TO TABLE 4.2 FOR DESCRIPTIONS OF HAZARDOUS WASTE STORAGE AREAS.
SOURCE: CASTLE AFB INSTALLATION DOCUMENTS

TABLE 4.3
HAZARDOUS WASTE STORAGE AT CASTLE AFB

Site	Facility Name	Facility No.	Description of Storage Facility	Waste Materials in Storage
HWS-1	POL Storage Area	Behind Bldg. 65	2-5,000 gal. and 1-10,000 gal. U/G tanks	Waste fuels, oils and other petroleum products
HWS-2	OMS Washrack	Near Bldg. 1521	12,500 gal. A/G tank	Waste PD-680 and oil
HWS-3	AGE Shop	Near Bldg. 1325	1,000 gal. U/G tank	Waste oil
HWS-4	Contaminated Fuel Storage	Near Facility 1313	5,000 gal A/G tank	Contaminated Fuel
HWS-5	Hazardous Waste Drum Storage Area	Facility 1521	Covered, posted shed with concrete berm	Drums of waste oil, solvents, stripper and other miscel-laneous chemi-cals
HWS-6	DPDO Storage	Facility 1203	Fenced/asphalt storage yard	PCB transform-ers and PCB contaminated soil stored in drums

U/G - Underground
A/G - Aboveground

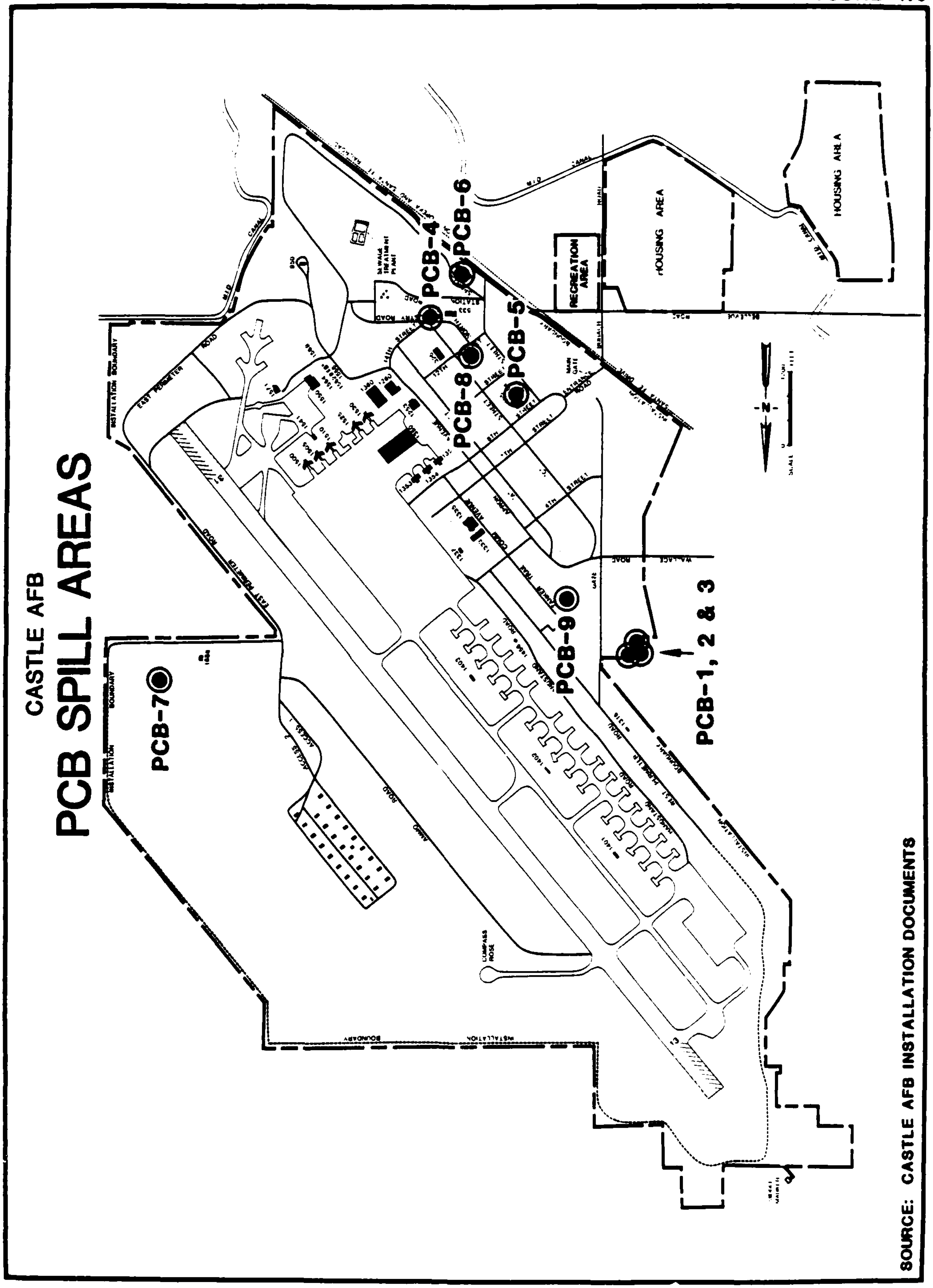
Areas of Potential PCB Contamination

Nine sources of potential PCB contamination were identified at Castle AFB (Figure 4.5). The DPDO storage yard located at the western corner of the base is the site of several potential spills (PCB Spill Nos. 1, 2 and 3) from out-of-service transformers in storage. Cleanup of these sites has been initiated but it is not known whether all the contaminated areas resulting from the spills were cleaned-up at the time this study was conducted. A small PCB spill occurred between 1979 and 1981 from a transformer located by Building 534 (PCB Spill No. 4), the spill was cleaned up in October 1982 and the contaminated soils were removed to the DPDO storage yard. Another small transformer leak was detected by Building 404 (PCB Spill No. 5). The contaminated soils around this leak were also excavated and stored in drums at the DPDO storage yard. Another PCB spill (1-15 gallons, quantity uncertain) occurred at Building 851 and the street adjacent to the building (PCB Spill No. 6). The spill was reported to have been cleaned up the following day. Building 1880 was another site of potential PCB contamination (PCB Spill No. 7). The spill was reported to have involved less than one gallon of PCB contaminated oil and all the contamination was promptly cleaned-up. PCB Spill No. 8 occurred in May 1982 at Building 360. Reports indicate that between 15 and 30 gallons of PCB contaminated oil (PCB concentration 7 ppm) spilled in the area. The site was cleaned up by June 1982. PCB Spill No. 9 involved a small transformer leak in Building 1213 which was detected May 1983. The leak occurred on a concrete floor and was immediately cleaned up the day after it was detected.

DESCRIPTION OF PAST ON-BASE TREATMENT AND DISPOSAL METHODS

The facilities on Castle AFB which have been used for the management and disposal of waste can be categorized as follows:

- Landfills
- Chemical Disposal Pits
- Sewage Treatment Plant and Industrial Waste Treatment Plant
- Storm Sewers



CASTLE AFB
PCB SPILL AREAS

SOURCE: CASTLE AFB INSTALLATION DOCUMENTS

Landfills

Five landfills, used for the disposal of refuse, were identified at Castle AFB. Landfill locations have been identified on Figure 4.6 and a summary of pertinent information concerning each landfill has been presented in Table 4.4.

Landfill No. 1

Landfill No. 1 is located in the southern sector of the base in an area that was once a wastewater effluent evaporation pond. The landfill is approximately 30 acres and was used for disposal between 1940 and 1950. Wastes were placed in trenches and burned daily. The disposal operation was discontinued because of smoke complaints from a neighboring rancher. Only a small quantity of waste chemicals and petroleum products are suspected of being disposed of directly in this landfill. However chemical disposal pits were also located within the boundary of this landfill and these pits are discussed in a separate section entitled chemical disposal pits.

Landfill No. 2

Landfill No. 2 is located just east of Landfill No. 1. The site comprises three trenches each about 400 feet long. The landfill received primarily general refuse and only small quantities of waste chemicals are suspected of having been disposed of in this landfill.

Landfill No. 3

Landfill No. 3 is one of the smallest landfills at Castle AFB. The site encompasses two acres located on the northeast portion of the base. The trenches were generally eight feet deep because of hardpan underlying the site. This landfill was eventually abandoned because of the shallow trenches and drainage swale which formed the western boundary of the landfill. The landfill is suspected of receiving small quantities of chemicals over its life.

Major differential settlement has occurred over the surface area which will trap surface runoff and increase the likelihood of leachate generation.

Landfill No. 4

Landfill No. 4 is the largest landfill at the base (See Figure 4.7). It comprises over 14 acres and was used from 1957 to 1970 to dispose of general refuse. Only small quantities of chemicals are

FIGURE 4.6

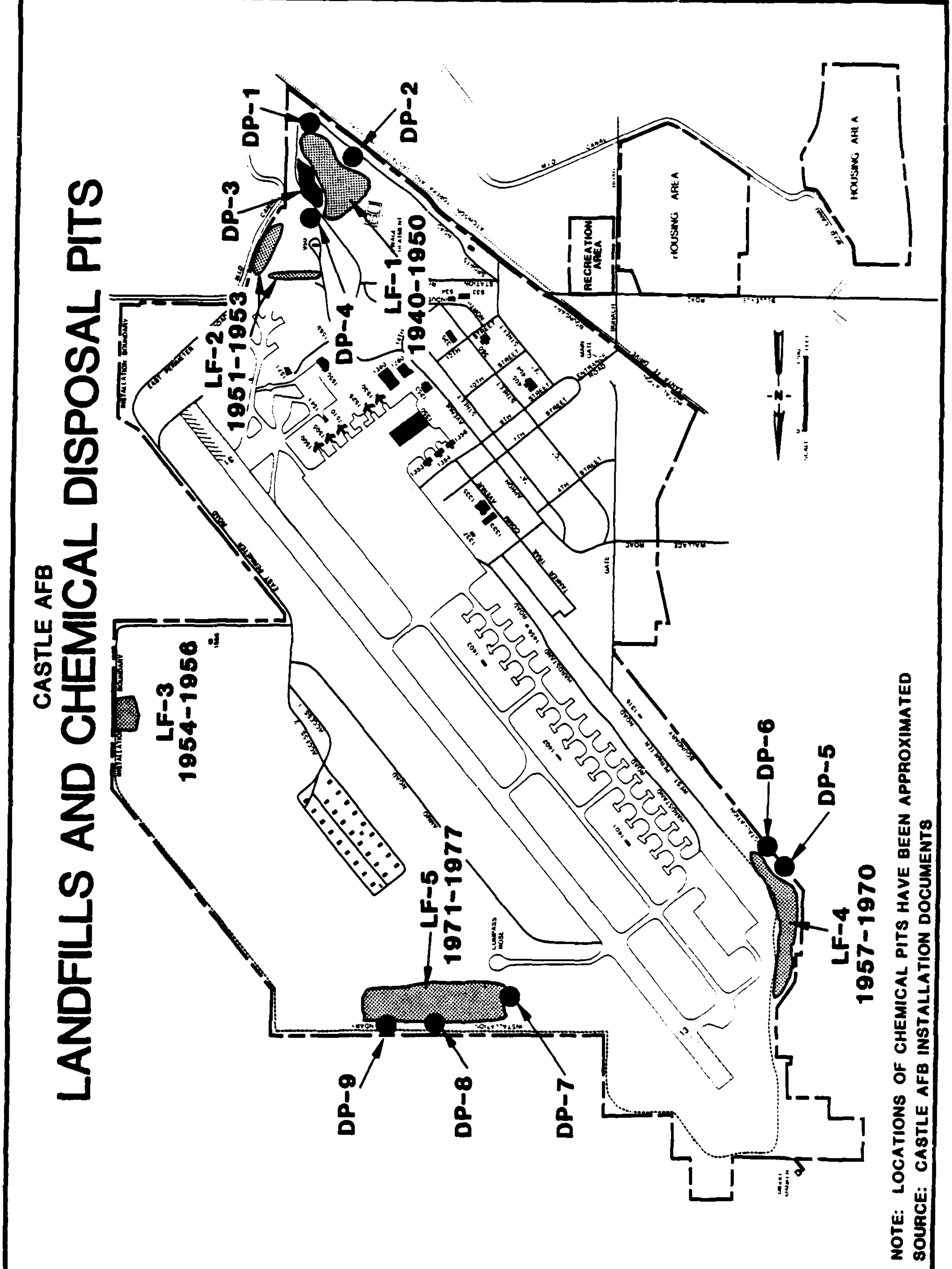

CASTLE AFB
LANDFILLS AND CHEMICAL DISPOSAL PITS
DP-1
DP-2
DP-3
DP-4
LF-1
1940-1950
LF-2
1951-1953
LF-3
1954-1956
LF-4
1957-1970
LF-5
1971-1977
DP-5
DP-6
DP-7
DP-8
DP-9
HOUSING AREA
HOUSING AREA
RECREATION AREA
COMPASS ROSE
NOTE: LOCATIONS OF CHEMICAL PITS HAVE BEEN APPROXIMATED
SOURCE: CASTLE AFB INSTALLATION DOCUMENTS

TABLE 4.4
SUMMARY OF LANDFILL DISPOSAL SITES

Landfill	Operation Period	Approximate Size (acres)	Depth (feet)	Type of Waste	Estimated Waste Quantity (cu. yd.)	Method of Operation	Closure Status	Surface Drainage
Landfill No. 1	1940-1950	30	12	General Refuse[1]	20,000	Trench and Fill Daily Burning	Closed, used as effluent spray irrigation field	To Canal Creek
Landfill No. 2	1951-1953	0.5	12	General Refuse[1]	6,000	Trench and Fill	Closed, earth covered with grass established	To Canal Creek
Landfill No. 3	1954-1956	2	8	General Refuse[1]	6,000	Trench and Fill	Closed, earth covered with grass established	To Canal Creek
Landfill No. 4	1957-1970	14	12	General Refuse[1]	26,000	Trench and Fill	Closed, earth covered with grass established	To Canal Creek
Landfill No. 5	1971-1977	10	12	General Refuse[1] Drums of Chemicals	12,000	Trench and Fill	Closed, earth covered with grass established	To Canal Creek

[1] General Refuse - includes small quantities of chemicals.

suspected of being disposed of in this landfill. The surface of this landfill has experienced severe differential settlement ranging in depth from 12 to 18 inches. This settlement will trap surface runoff and increase the likelihood of leachate generation.

Landfill No. 5

Landfill No. 5 was the last landfill to be utilized at Castle AFB (See Figure 4.2). The landfill received general refuse and at least one trench was utilized for the disposal of drums of chemicals. The landfill was closed in 1977 and part of the surface area has been used as a hardfill area. Other portions of the landfill have experienced severe differential settlement as described previously for the above landfills.

Chemical Disposal Pits (DP)

Nine chemical disposal pits were used for the disposal of bulk waste chemicals at Castle AFB. The chemical disposal pits have been identified on Figure 4.6. The chemical disposal pits were generally located on the periphery of the landfills and utilized when the landfill was being operated. The following is the approximate period of operation:

Chemical Disposal Pit	Location to Nearest Landfill	Period of Operation
No. 1, 2, 3	No. 1	1940-1950
No. 4	No. 2	1951-1953
No. 5, 6	No. 4	1954-1970
No. 7, 8, 9	No. 5	1971-1977

Chemical Disposal Pit Nos. 1, 2, and 3

Chemical Disposal Pit Nos. 1, 2, and 3 are located within the boundary of Landfill No. 1. Disposal Pit No. 1 was used to bury low-level radioactive vacuum tubes in the 1940's. The tubes were placed in a pipe and sealed in concrete. Disposal Pit No. 2 received sludge from a small cadmium plating operation and cyanide wastes from a small metal parts heat treatment pot. The pot was described as 18 inches in diameter and 24 inches deep. The plating operation was reported to exist on base from the mid 1940's to 1960. Disposal Pit No. 3 was used to bury barrels of chemicals.

Chemical Disposal Pit Nos. 4, 5, 6, 7, 8, and 9

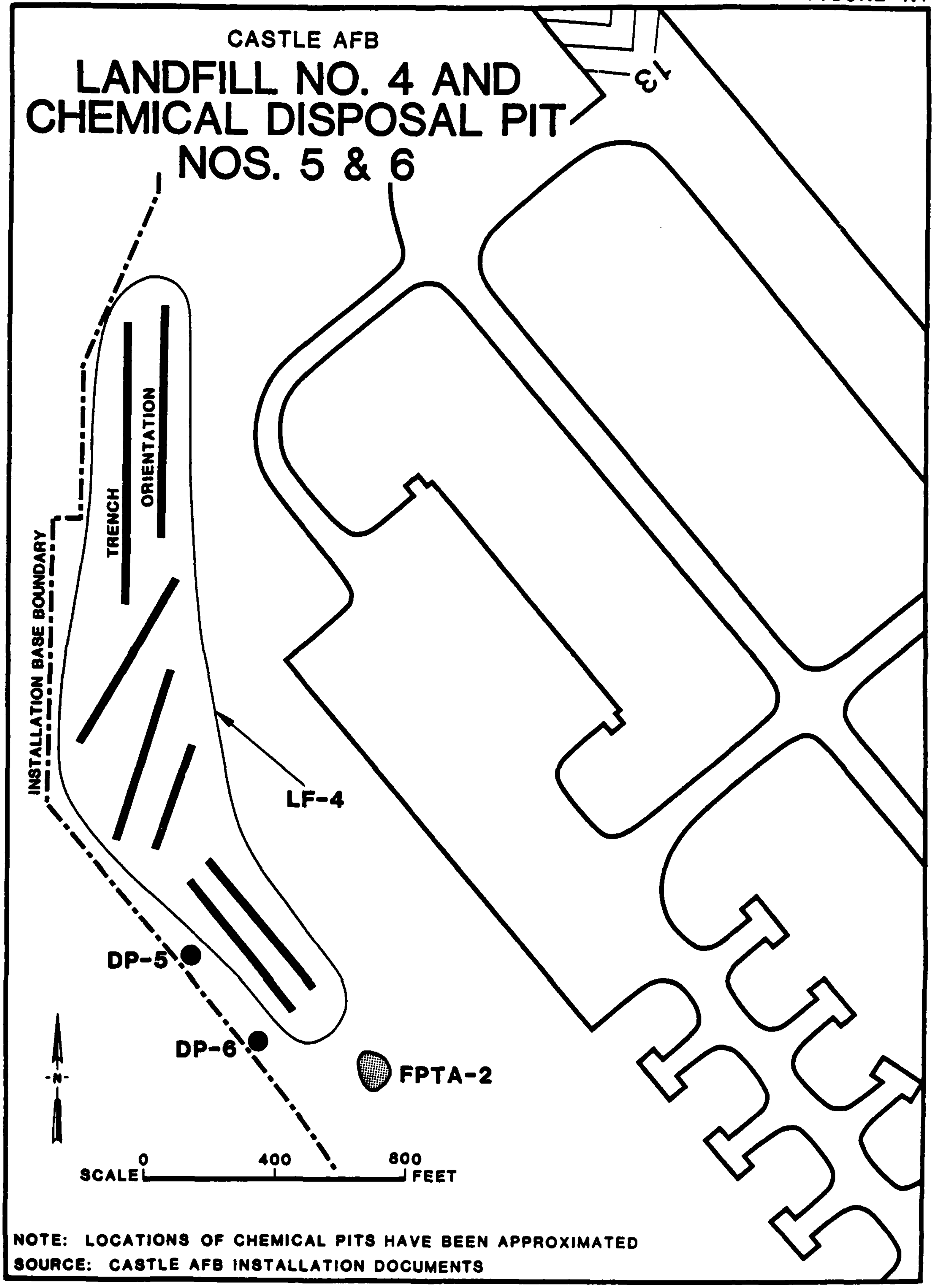
Most of the chemical disposal pits were located adjacent to roads so that a bowsers could be used to haul chemicals to the pits. This was true of Disposal Pit Nos. 4, 5, 6, 7, 8, and 9. These pits received waste solvents, oils and other miscellaneous chemicals. It was reported that Disposal Pit Nos. 7 and 8 received mostly waste oils and sludge from tetraethyl lead gasoline storage tanks.

It should be pointed out that the locations for Disposal Pit Nos. 5, 6, 8, and 9 are approximate. Disposal Pits No. 5 and 6 were located on the inside of the fire break road adjacent to the fence and the approximate location is shown on Figure 4.7. Disposal Pits No. 8 and 9 are equidistant (about 200 feet) from the only electrical manhole located on the perimeter road (Figure 4.8). A portion of Disposal Pit No. 8 is still visible adjacent to the road. Oil stained soil marks the boundary of the pit.

Sewage Treatment Plant

Castle AFB has operated a sewage treatment plant (STP) from the 1940's through the present. The plant is located in the southwest portion of the base. The treatment system has incorporated several different processes over the years. The treatment facility consists of two parallel plants, each having a primary clarifier, trickling filter and a final clarifier. During the 1940's and early 1950's, the effluent from the treatment plant was discharged into a large shallow evaporation pond which was located in the vicinity of Landfill No. 1. From the 1950's until 1977, the treated sanitary wastes were discharged directly to Canal Creek. During the early 1960's separate industrial sewers were installed. The industrial waste was segregated and treated in a system which consisted primarily of oil/water separation. The effluent from the industrial system was discharged to a nearby evaporation pond (Refer to discussion on Discharge Area No. 6). In 1977, the State ordered the evaporation pond closed and both the domestic and industrial wastes were comingled in an aeration pond and then sprayed onto a parcel of land located in the southeast corner of the base. The area undergoing spray irrigation was formerly used as a base landfill (Landfill No. 1). The practice of spray irrigation of the wastewater effluent is now under review.

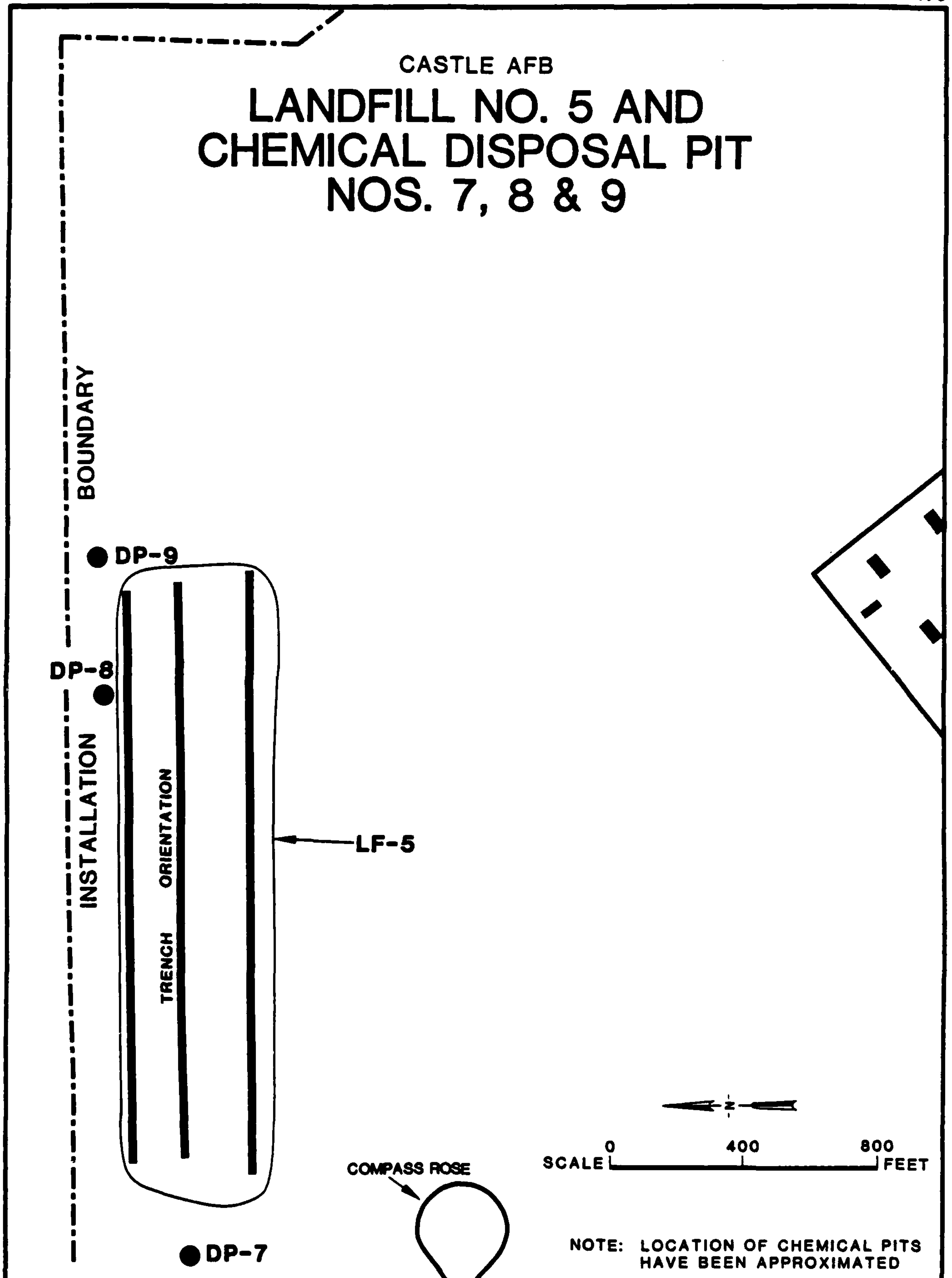
FIGURE 4.7



ES ENGINEERING-SCIENCE

CASTLE AFB

LANDFILL NO. 5 AND CHEMICAL DISPOSAL PIT NOS. 7, 8 & 9



SOURCE: CASTLE AFB INSTALLATION DOCUMENTS

Storm Drainage

The surface drainage system at Castle AFB comprises storm sewers which discharge to well defined drainage ditches. The major drainage ditches are joined in the southeast corner of the base where they exit the base property. Most of the storm waters exiting the base flow into Canal Creek. (Refer to Chapter 3, Drainage, for additional information.)

Since the initial operations began at Castle AFB, the storm sewers served as one method for disposing of liquid wastes. Any spills which occurred in maintenance areas were routinely washed down the storm sewers. Fuel spills occurring along the flightline areas were rinsed directly into the surface drainage system. Many of the washracks located throughout the base were also known to have discharged into the surface drainage system. It is therefore likely that only until recently, the storm drainage system was the carrier of soaps, solvents, fuels and oils. Many of the non-miscible materials (i.e., fuels and oils) were retained on-base by means of booms and other containment measures. The miscible compounds would however have been discharged with the storm water.

EVALUATION OF PAST DISPOSAL ACTIVITIES AND FACILITIES

The review of past operation and maintenance functions and post waste management practices at Castle AFB has resulted in the identification of sites which were initially considered as areas of concern with regard to the potential for contamination, as well as the potential for the migration of contaminants. These sites were evaluated using the Decision Tree Methodology referred to in Figure 1.1. Those sites which were considered as not having a potential for contamination were deleted from further consideration. Those sites which were considered as having a potential for the occurrence of contamination and migration of contaminants were further evaluated using the Hazard Assessment Rating Methodology (HARM). Table 4.5 identifies the decision tree logic used for each of the areas of initial concern. Operational procedures at several of the sites studied were deemed to warrant review and modification under other base environmental programs. These sites were

TABLE 4.5
SUMMARY OF DECISION TREE LOGIC FOR AREAS OF INITIAL
ENVIRONMENTAL CONCERN AT CASTLE AFB

Site Description	Potential For Contamination	Potential For Contaminant Migration	Potential For Other Environmental Concern[1]	Refer to Base Environmental Programs	HARM Rating
Landfill No. 1	YES	YES	NO	YES	YES
Landfill No. 2	YES	YES	NO	N/A	YES
Landfill No. 3	YES	YES	NO	N/A	YES
Landfill No. 4	YES	YES	NO	N/A	YES
Landfill No. 5	YES	YES	NO	N/A	YES
Chemical Disposal Pit No. 1	YES	YES	NO	N/A	YES
Chemical Disposal Pit No. 2	YES	YES	NO	N/A	YES
Chemical Disposal Pit No. 3	YES	YES	NO	N/A	YES
Chemical Disposal Pit No. 4	YES	YES	NO	N/A	YES
Chemical Disposal Pit No. 5	YES	YES	NO	N/A	YES
Chemical Disposal Pit No. 6	YES	YES	NO	N/A	YES
Chemical Disposal Pit No. 7	YES	YES	NO	N/A	YES
Chemical Disposal Pit No. 8	YES	YES	NO	N/A	YES
Chemical Disposal Pit No. 9	YES	YES	NO	N/A	YES
Discharge Area No. 1	YES	YES	NO	YES	YES
Discharge Area No. 2	YES	YES	NO	YES	YES
Discharge Area No. 3	YES	YES	NO	YES	YES
Discharge Area No. 4	YES	YES	NO	N/A	YES
Discharge Area No. 5	YES	YES	NO	YES	YES
Discharge Area No. 6	YES	YES	NO	N/A	YES
Discharge Area No. 7	YES	YES	NO	N/A	YES
Discharge Area No. 8	YES	YES	NO	N/A	YES
Fire Protection Training Area No. 1	YES	YES	NO	N/A	YES
Fire Protection Training Area No. 2	YES	YES	NO	N/A	YES
Fire Protection Training Area No. 3	YES	YES	NO	N/A	YES
Fuel Spill No. 1	YES	YES	NO	N/A	YES
Fuel Spill No. 2	YES	YES	NO	N/A	YES
Fuel Spill No. 3	YES	YES	NO	N/A	YES
Fuel Spill No. 4	YES	YES	NO	N/A	YES
Contaminated PCB Area No. 1	YES	YES	NO	N/A	YES
Contaminated PCB Area No. 2	YES	YES	NO	N/A	YES
Contaminated PCB Area No. 3	YES	YES	NO	N/A	YES
Contaminated PCB Area No. 4	YES	YES	NO	N/A	YES
Contaminated PCB Area No. 5	YES	YES	NO	N/A	YES
Contaminated PCB Area No. 6	YES	YES	NO	N/A	YES
Contaminated PCB Area No. 7	YES	YES	NO	N/A	YES
Contaminated PCB Area No. 8	YES	YES	NO	N/A	YES
Contaminated PCB Area No. 9	YES	NO	NO	N/A	NO

[1] Other Environmental Concerns - Includes environmental problems which are not within the scope of this study (i.e., air pollution, occupational safety requirements).

N/A - Not Applicable

identified under the column "Refer to Base Environmental Programs" in Table 4.5.

All of the sites identified on Table 4.5 were evaluated using the Hazard Assessment Rating Methodology. The HARM process takes into account characteristics of potential receptors, waste characteristics, pathways for migration, and specific characteristics of the site related to waste management practices. The details of the rating procedures are presented in Appendix G. Results of the assessment for the sites are summarized in Table 4.6. The HARM system is designed to indicate the relative need for follow-on action. The information presented in Table 4.6 is intended for assigning priorities for further evaluation of the Castle AFB disposal areas (Chapter 5, Conclusions and Chapter 6, Recommendations). The rating forms for the individual waste disposal sites at Castle AFB are presented in Appendix H. Photographs of some of the key disposal sites are included in Appendix I.

OVERVIEW OF TCE GROUND-WATER EVALUATION

In 1978 as a result of a directive from SAC Headquarters, samples were taken from the base wells and analyzed for TCE. Thereafter samples were taken intermittently and within the last two years on a monthly basis. TCE concentrations generally range between 5 and 10 ppb with a maximum value of 46.4 ppb reported in August 1981 (see Table 3.6). Well No. 3 has on a number of occasions reported higher TCE amounts than either Well No. 2 or No. 4, both of which are only approximately 200 feet away. The variability in the data is not explainable at this time.

The Air Force has a TCE guideline for drinking water (endorsed by the National Academy of Sciences) of 270 ppb. California has an "action level" of 5 ppb while EPA has not as yet established a permissible level of TCE in drinking water.

In 1981, seven test wells approximately 100 feet deep were placed into the unconfined shallow aquifer to locate the TCE source. Previous thinking was that the spray irrigation of Landfill No. 1 was responsible for the TCE showing up in the base wells. Sampling data has indicated TCE values ranging from trace to 136 ppb (see Table 3.8). TCE levels in private wells adjacent to the base vary from trace amounts to 24 ppb (see Table 3.9). A TCE plume reported in Figure 3.13 shows contaminants

TABLE 4.6
SUMMARY OF HARM SCORES FOR POTENTIAL CONTAMINATION SOURCES

Rank	Site Name	Receptor Subscore	Waste Characteristics Subscore	Pathways Subscore	Waste Management Factor	Overall Total Score
1	Landfill No. 1 Chemical Disposal Pits Nos. 1, 2 and 3	74	80	93	1.0	82
2	Fire Protection Training Area No. 1	72	100	56	1.0	76
2	Landfill No. 5 Chemical Disposal Pits No. 7, 8 and 9	66	100	63	1.0	76
4	Discharge Area No. 1	72	72	71	1.0	72
5	Discharge Area No. 8	73	60	80	1.0	71
6	Fuel Spill No. 1	65	80	71	0.95	68
7	Discharge Area No. 4	68	60	71	1.0	66
7	Discharge Area No. 7	76	60	63	1.0	66
7	Landfill No. 4 Chemical Disposal Pit Nos. 5 and 6	66	70	63	1.0	66
10	Chemical Disposal Pit No. 4	67	70	56	1.0	64
10	Discharge Area No. 5	75	45	71	1.0	64
10	Discharge Area No. 2	67	54	71	1.0	64
10	Fuel Spill No. 4	65	64	63	1.0	64
10	Discharge Area No. 3	76	45	71	1.0	64
15	PCB Spill Nos. 1, 2, and 3	74	40	71	1.0	62
16	Fuel Spill Nos. 2 and 3	65	40	71	1.0	59
17	Fire Protection Training Area No. 3	67	40	56	1.0	54
18	Discharge Area No. 6	49	45	63	0.95	50
18	Landfill No. 2	70	16	63	1.0	50
18	Fire Protection Training Area No. 2	67	40	42	1.0	50
21	Landfill No. 3	66	16	63	1.0	48
22	PCB Spill No. 4	76	60	71	0.1	7
22	PCB Spill No. 6	76	60	71	1.0	7
24	PCB Spill No. 5	78	60	56	0.1	6
24	PCB Spill No. 8	75	40	71	1.0	6
26	PCB Spill No. 7	39	40	56	1.0	5

in the unconfined shallow aquifer moving toward the base boundary. The axis of the plume indicates that the source of the TCE may originate from Discharge Area No. 8. Sufficient information is not available to determine the extent of contamination of the intermediate confined aquifer from which the base draws its drinking water. TCE may be contaminating these wells by the following mechanisms:

- o Leakage of water from the unconfined aquifer to the intermediate confined aquifer through possible permeable zones in the red clay.
- o Leakage of water into perforations and/or into the well annulus of the drinking well.
- o Localized cone of depression induced by pumping of base wells thereby drawing water down from the unconfined aquifer.

During the Phase I study, special attention was paid to operations handling and disposing of TCE. They are as follows:

Operation	Location	TCE Amount (gals/month)	Time
Aircraft Engine Maintenance	Bldg. 51	--	1945 - 1960
Liquid Oxygen Plant	Bldg. 1314	15	1950 - 1980
Defensive Fire Control	Bldg. 1335	110	1950's - 1975
Jet Engine Intermediate Maintenance	Bldg. 1260	5	1950's - 1976
84 FIS Maintenance Facility	Bldg. 1550	5	Pre1973 - 1976

Conversations with personnel who worked in the aircraft engine maintenance and defense fire control areas remembered TCE being removed in drums and disposed of but not discharged to the ground. TCE utilized at the liquid oxygen plant was discharged to the ground but in such small quantities that most probably evaporated. Considering the location of the liquid oxygen plant and ground water movement at the base, this source could not account for the current ground water contamination. The TCE disposed of in the ditch south of Building 1550 is a likely source of the TCE contamination. Further ground-water monitoring should

be conducted to confirm the contamination source. While TCE was used at the base, there were designated fire training protection areas, chemical disposal pits and landfill trenches which received waste chemicals. Therefore, it is reasonable to assume that some TCE was disposed in any or all of the above areas.

SUMMARY

The following is a summary of major findings associated with evaluating TCE usage, handling, disposal practices, and ground-water contamination:

1. TCE has been shown to have contaminated ground water in the unconfined shallow aquifer. The contamination area of 150 acres is both on and off the base (see Figure 3.13). TCE values range from trace amounts to 136 ppb.

2. A plume of TCE in the unconfined shallow aquifer has been identified (from very limited data) and shown to be moving toward the area of the base's drinking water wells and beyond to the base boundary. The shape of the plume is not completely understood, i.e., the plume axis is not parallel to the general direction of ground water movement. The limited data available suggests that the source of the contamination may have originated from the discharge of TCE in a ditch behind Building 1550. However, landfill No. 1 could be an alternative source due to the type of wastes which are suspected of having been disposed in the area and the excessive amounts of water being sprayed over the landfill which could be contributing to the migration of contaminants.

3. TCE has been shown to be in the drinking water in concentrations ranging from 5 to 10 ppb with a maximum value of 46.4 ppb. Sufficient information is not available to determine the extent of contamination of the intermediate confined aquifer from which the base draws its drinking water. TCE may be contaminating these wells by the following mechansisms:

- o Leakage of water from the unconfined aquifer to the intermediate confined aquifer through possible permeable zones in the red clay.
- o Leakage of water into perforations and/or into the well annulus of the drinking well.
- o Localized cone of depression induced by pumping of base wells thereby drawing water down from the unconfined aquifer.

4. The record search has identified five major TCE users in the past. Available information indicates that TCE was drummed and hauled to disposal areas from three of the operations. The fourth -- the liquid oxygen plant discharged small quantities of TCE to the ground. However, the discharge area is hydraulically downgradient of the cantonment area and should not have contributed to the current documented problem. The fifth involved the direct discharge of TCE into the surface drainage system on the base. This area is located directly upgradient of the contaminated plume and hence is a likely source of the contamination.

SECTION 5
CONCLUSIONS

The goal of the IRP Phase I study is to identify sites where there is the potential for environmental contamination resulting from past waste disposal practices and to assess the probability of contaminant migration from these sites. The conclusions given below are based on the assessment of the information collected from the project team's field inspection, review of records and files, review of the environmental setting, and interviews with base personnel, past employees and state and local government employees. Table 5.1 contains a list of the potential contamination sources identified at Castle AFB and a summary of HARM scores for those sites.

LANDFILL NO. 1 AND CHEMICAL DISPOSAL PIT NOS. 1, 2, AND 3

Landfill No. 1 and Chemical Disposal Pits No. 1, 2, and 3 are all located in the same general area and were active during the same period (1940 to 1950). The site has a high potential for environmental contamination. The landfill received general refuse which was burned in trenches on a daily basis. Only small amounts of waste chemicals and petroleum are suspected of being disposed of directly in the landfill. However, the three chemical disposal pits located in the area were used to dispose of low-level radioactive vacuum tubes, tank bottoms from cadmium plating and cyanide from a heat treatment pot and other miscellaneous drums of chemicals. The landfill site is presently utilized to spray irrigate effluent from the industrial and sanitary wastewater treatment systems. The surface soils in the area typically comprise a sandy silt. Large portions of the base are known to be underlain with a hardpan. However, the area beneath this disposal site is one which may not contain a hardpan formation. The site received a HARM score of 82.

TABLE 5.1
PRIORITY RANKING OF POTENTIAL CONTAMINATION SOURCES

Rank	Site Name	Date of Operation or Occurrence	Overall Total Score
1	Landfill No. 1 Chemical Disposal Pits Nos. 1,2,and 3	1940-1950	82
2	Fire Protection Training Area No. 1	1955-1975	76
2	Landfill No. 5 Chemical Disposal Pits Nos. 7,8,and 9	1971-1977	76
4	Discharge Area No. 1	1950's-1983	72
5	Discharge Area No. 8	Pre 1973-1976	71
6	Fuel Spill No. 1	1977	68
7	Discharge Area No. 4	1950-1980	66
7	Discharge Area No. 7	Prior to 1979	66
7	Landfill No. 4 Chemical Disposal Pit Nos. 5 and 6	1957-1970	66
10	Chemical Disposal Pit No. 4	1950's	64
10	Discharge Area No. 2	1970's-1983	64
10	Discharge Area No. 3	1950-1983	64
10	Discharge Area No. 5	1950's-1982	64
10	Fuel Spill No. 4	Early 1960's	64
15	PCB Spill Nos. 1,2,3	1980-1983	62
16	Discharge Area No. 6	1960's-1977	59
17	Fire Protection Training Area No. 3	1976-present	54
18	Fuel Spill Nos. 2 and 3	1950's-1977	50
18	Landfill No. 2	1951-1953	50
18	Fire Protection Training Area No. 2	1962-1967	50
21	Landfill No. 3	1954-1956	48
22	PCB Spill No. 6	1982	7
22	PCB Spill No. 4	1970-1980	7
24	PCB Spill No. 8	1982	6
24	PCB Spill No. 5	1979-1982	6
26	PCB Spill No. 7	1980	5

FIRE PROTECTION TRAINING AREA NO. 1

Fire Protection Training Area No. 1 has a high potential for environmental contamination. The site was used for fire protection training exercises from about 1955 until 1975. A variety of combustible waste chemicals were accumulated in a two foot deep unlined pit and burned weekly. Other chemicals were stored in the area in 55-gallon drums and later in a 2,000-gallon tank and applied to an adjacent burn area during training exercises. The area soils are of a sandy silty nature. The site received a HARM score of 76.

LANDFILL NO. 5 AND CHEMICAL DISPOSAL PIT NOS. 7, 8, AND 9

Landfill No. 5 and Chemical Disposal Pits Nos. 7, 8, and 9 are all located in the same general area along the northern border of the base. The site has a high potential for environmental contamination. The landfill received general refuse and at least one trench was utilized for the disposal of drums of chemicals. The chemical disposal pits located adjacent to the landfill received waste oils, fuel sludges and other miscellaneous chemicals and solvents. The disposal site was active from around 1970 until 1977. Soils in the area are of a sandy silty nature. The site may be underlain by a hardpan which could create a shallow perched aquifer. The site received a HARM score of 76.

DISCHARGE AREA NO. 1

Discharge Area No. 1 has a high potential for environmental contamination. The site is a low lying area which received runoff from the engine test stands since 1956. The runoff was contaminated with JP-4, PD-680, and soap. A slight surface discoloration was observed in the discharge area. Surface soils in the area are of a sandy silty nature. The site received a HARM score of 72.

DISCHARGE AREA NO. 8

Discharge Area No. 8 has a high potential for environmental contamination. It has been reported that approximately five gallons per month of TCE had been discharged to a surface drainage ditch behind (south of)

Building 1550. The TCE was used in an ultrasonic cleaner at this facility until 1976. Reports have indicate that this practice has occurred since at least 1973 and was likely occurring for many years prior to 1973.

A plume of TCE in the unconfined shallow aquifer has been identified and shown to be moving toward the area of the base's drinking water wells and beyond to the base boundary. The source of the TCE has not been conclusively tied to Discharge Area No. 8; however, the location of the source relative to the orientation of the plume indicates that this disposal area may likely be the origin of the contamination. TCE has been detected in the base drinking wells which withdraw water from the intermediate confined aquifer. No information is available to quantify the extent of contamination within this aquifer. Discharge Area No. 8 received a HARM score of 71.

FUEL SPILL NO. 1

Fuel Spill No. 1 has a high potential for environmental contamination. The spill occurred in 1977 at Pumphouse No. 3. It was estimated that 21,000 gallons of JP-4 were spilled and only 1,000 gallons were recovered. The remainder of the fuel either evaporated or percolated into the sandy silty soil. The area is suspected to be underlain by a hardpan which would tend to cause the fuel to move laterally with any perched groundwater. The site received a HARM score of 68.

DISCHARGE AREA NO. 4

Discharge Area No. 4 has a moderate potential for environmental contamination. TCE was used to clean filters at the Liquid Oxygen Plant during the 1950's and up until 1980. The spend TCE was poured on the ground next to the plant. Since the compound is very volatile, it is suspected that most of the solvent would have evaporated before it could percolate into the sandy silty soils. The site received a HARM score of 66.

DISCHARGE AREA NO. 7

Discharge Area No. 7 has a moderate potential for environmental contamination. The site received rinse water runoff from cleaning pesticide application equipment from the 1940's until 1979. The site received a HARM score of 66.

LANDFILL NO. 4 AND CHEMICAL DISPOSAL PIT NOS. 5 AND 6

Landfill No. 4 and Chemical Disposal Pits Nos. 5 and 6 are all located in the same general area. The site has a moderate potential for environmental contamination. Both the landfill and disposal pits were active from the late 1950's until 1970. The l :dfill was used primarily to dispose of general refuse. The adjacent disposal pits received waste solvents, oils and other miscellaneous chemicals. Surface soils in the area are of a sandy silty nature. There are no soil borings or wells in the area to verify the presence of hardpan. Ths site received a HARM score of 66.

CHEMICAL DISPOSAL PIT NO. 4

Chemical Disposal Pit No. 4 has a moderate potential for environmental contamination. The pit was reported to have received waste solvents, oils and other miscellaneous chemicals during the 1950's. Surface soils in the area are of a sandy silty nature. The site is suspected to be underlain with a hardpan formation. Disposal Pit No. 4 received a HARM score of 64.

DISCHARGE AREA NO. 5

Discharge Area No. 5 is located between the main aircraft washrack and a surface drainage ditch and has a moderate potential for environmental contamination. On frequent occasions, waste from the washrack consisting of oils, PD-680 and other solvents were discharged directly to the adjacent storm drainage system. Wastes would either have been deposited in the ditch or were discharged off-base with the storm waters. The site received a HARM score of 64.

DISCHARGE AREA NO. 2

Discharge Area No. 2 has a moderate potential for environmental contamination. The site has received the runoff from the AGE washrack since the 1960's. Contaminants in the washrack runoff included cleaning solvents, oils and soaps. Soils in the area are void of vegetation and have a distinct oily coloration. The site received a HARM score of 64.

DISCHARGE AREA NO. 3

Discharge Area No. 3 has a moderate potential for environmental contamination. Since the early 1950's, the area has received the runoff generated from cleaning the equipment used by the Civil Engineering Squadron. Runoff from the washrack has included cleaning solvents, oils and possibly low concentrations of herbicides generated from rinsing the spray application equipment. The runoff from the washrack flows beneath the base boundary fence directly into a drainage ditch running along the base boundary line. The site receive a HARM score of 64.

FUEL SPILLS NOS. 2, 3, AND 4

Fuel Spills Nos. 2, 3, and 4 have a moderate potential for environmental contamination. All of these spills occurred along the hydrant system which services the Flightline. Fuel Spills No. 2 and 3 occurred at Pumphouses No. 1 and No. 2 between the 1950's and 1977. The spills were reported to have ranged in size from several hundred to several thousands of gallons. No clean-up efforts were known to have occurred. Fuel Spill No. 4 occurred during the 1960's as a result of a pipe rupture in the hydrant system. At the time, fuel was detected in the surface soils. The pipe was immediately replaced upon detection of the leak, however; the amount lost was never determined. Fuel Spill No. 4 received a HARM score of 64. Fuel Spills No. 2 and No. 3 received a HARM score of 50.

PCB SPILL NOS. 1, 2, AND 3

PCB Spill Nos. 1, 2, and 3 have a moderate potential for environmental contamination. PCB Spill Nos. 1,2, and 3 occurred on an asphalt

pad in the DPDO storage yard. It is not known if the contaminated areas were properly cleaned. The site received a HARM score of 62.

LOW POTENTIAL SITES

The remainder of the sites listed in Table 5.1 pose a low potential for environmental contamination.

SECTION 6
RECOMMENDATIONS

Twenty-six sites were identified at Castle AFB as having the potential for environmental contamination and have been evaluated using the HARM system. This evaluation assessed their relative potential for environmental contamination and identified those sites where further study and monitoring may be necessary. Of primary concern are those sites with a high potential for environmental contamination that should be investigated in Phase II. Sites of secondary concern are those with moderate potential for environmental contamination. Further investigation at these sites may also be recommended. No further monitoring is recommended for those sites with low potential for environmental contamination, unless other data collected indicate a potential problem could exist at one of these sites. All sites have been reviewed with regard to future land use restrictions which may be applicable due to the nature of each site.

PHASE II MONITORING RECOMMENDATIONS

The following recommendations are made to further assess the potential for environmental contamination from waste disposal areas at Castle AFB. The recommended actions are generally one-time sampling programs to determine if contamination does exist at the site. (Low annual and sporatic monthly precipitation may require multiple sampling of ground-water wells.) All ground-water sampling wells should be constructed of four-inch steel casing, manufactured stainless steel screens, and should be properly developed. If contamination is identified, the sampling program may need to be expanded to further define the extent of contamination.

Geophysical surveys, consisting of electrical resistivity, electromagnetic and/or magnetometer techniques, are recommended prior to any well installations to attempt to delineate the horizontal and vertical extent of the site, any subsurface leachate plumes migrating from the

site and subsurface stratigraphy including the hardpan formation. The alternative approach to geophysical testing would be the conventional technique of test well drilling and ground-water sampling. The cost benefit of geophysical surveys over test drilling can be understood by comparisons of time, cost and data availability.

Specific Phase II monitoring recommendations for the sites identified during this study are discussed below and summarized in Table 6.1.

1. Identification of the Method of Migration of TCE Contaminants - To identify the TCE pathway between the shallow unconfined aquifer and the intermediate confined aquifer the following phased investigation is recommended.

   Phase A:

   The base drinking water well numbers 1, 2, 3 and 4 which extend into the intermediate confined aquifer should be inspected with a downhole color television camera to confirm the construction of each well and to attempt to locate any casing cracks which can communicate contamination. Since cracks may be too small to be seen by the camera, a downhole geophysical survey is also recommended for each well. The survey should consist of a full suite of logs including a fluid conductivity log, a differential temperature log, a flowmeter log and a caliper log to locate small cracks in the casing. The production well pumps will need to be removed from the wells prior to the surveys. During the fluid conductivity, differential temperature and flowmeter logs, a submersible pump of sufficient pumping capacity to induce flow from any cracks should be installed. These logs should locate any cracks in the casing. If cracks are identified, they should be sealed by a cement grout. Water sampling should be conducted to confirm the impact of the grouting. If no cracks are identified then the contamination maybe entering the wells through the perforations at the bottom of the well or the uncased bottom portion of the casing via the well annulus (space between the wall of the hole and the casing).

TABLE 6.1
RECOMMENDED MONITORING PROGRAM FOR PHASE II
Castle Air Force Base

Site	Recommended Monitoring	Remarks
TCE Contaminant Plume	Two phase investigation to determine pathway of the migration from shallow unconfined aquifer to the drinking water wells. The investigation should entail the following tasks: Phase A o Confirm well construction for base water supply wells with downhole color TV camera. Locate any casing cracks o Conduct downhole geophysical survey including fluid conductivity log, differential temperature log, flowmeter log and caliper log. o Seal any identified cracks with pressurized gravity. Phase B o Conduct Phase B if Phase A investigation reveals no casing cracks exist o Conduct natural gamma ray log, density log and neutron log of base drinking water wells o Conduct interaquifer pump test to determine if permeable zones between the aquifers are allowing contamination to migrate.	
Landfill No. 1 Chemical Disposal Pit Nos. 1, 2, 3 and 4 Discharge Area No. 1	Conduct geophysical survey of area. Install three upgradient wells, four downgradient wells and two downgradient lysimeters. Wells and lysimeters for parameters in Table 6.2, List A.	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.
Discharge Area No. 8.	Conduct geophysical survey of area. Install shallow wells to determine the presence and degree of TCE contamination in the general area. Collect three sediment samples in the ditch south of Building 1550 and analyze for TCE.	The number of monitoring wells will depend upon the results of the TCE contaminant plume investigation. Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.
Fire Protection Training Area No. 1	Conduct geophysical survey of area. Install one upgradient and two downgradient wells and two shallow downgradient lysimeters. Water samples should be analyzed for parameters in Table 6.2, List B.	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.
Landfill No. 5 Chemical Disposal Pit Nos. 7, 8 and 9	Conduct geophysical survey of area. Install one upgradient and four downgradient wells, and two shallow downgradient lysimeters. Water samples should be analyzed for parameters in Table 6.2, List A. Regrade and revegetate landfill to minimize leachate generation.	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.

TABLE 6.1
(Continued)
RECOMMENDED MONITORING PROGRAM FOR PHASE II
Castle Air Force Base

Site	Recommended Action	Remarks
Landfill No. 4 Chemical Disposal Pit Nos. 5 and 6	Conduct geophysical survey of area. Install one upgradient and four downgradient wells. Well samples should be analyzed for parameters in Table 6.2, List A. Regrade and revegetate landfill to minimize leachate generation.	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.
PCB Spill Nos. 1, 2, 3	Collect three soil samples in area where spills occurred to confirm contaminanted materials have been removed.	
Fuel Spills Nos. 1, 2, 3, and 4	Install four shallow wells, downgradient from the general area of the fuel spills. Two wells should penetrate any hardpan found in the area and the remaining two wells should extend to the upper surface of the hardpan. The wells should be analyzed for TOC, oil and grease, total organic halogen and benzene.	
Discharge Areas		
Discharge Area No. 2	Remove visually contaminated soils. Modify disposal procedures to eliminate overland discharge.	
Discharge Area No. 3	Collect two soil samples from drainage ditch behind discharge area and analyze for parameters in Table 6.2, List A.	
Discharge Area No. 4	Collect two surface soil samples and analyze for TCE.	
Discharge Area No. 5	Collect three sediment samples from the drainage ditch receiving the release from this discharge area. The samples should be analyzed for the parameters in Table 6.2, List B.	
Discharge Area No. 7	Collect two surface soil samples in area and conduct a chlorinated hydrocarbon and organo-phosphate pesticide scan on these samples.	

Phase B:

If the Phase A investigation determines that no casing cracks exist, an investigation should be conducted to determine the extent of hydraulic connection between the shallow unconfined and the intermediate confined aquifers. The pathways for hydraulic connection may be either the well annulus or natural permeable zones existing between the aquifers. The first task of Phase B should be a complete evaluation of the natural gamma ray log, the density log and the neutron log of base drinking water wells 1, 2, 3 and 4 to detail the lithology, density and water-bearing zones outside the casing of each well. The density log may indicate zones of decreased subsurface density or voids where a vertical pathway in the annulus may exist. If voids are determined to exist, then those voids should be sealed by a pressurized cement grout method. Water sampling should be conducted to confirm the impact of the grouting.

The second step in Phase B should be an interaquifer pump test to determine if permeable zones between the aquifers are allowing contamination to migrate to the base drinking water wells. This test may be conducted using base drinking water wells, 1, 2, 3 and 4, installation test wells 13, 14, 16, 17 and 18 and off-base private wells 1 and 2, but additional wells may be necessary for an effective test.

These new wells should be constructed of eight-inch steel casings, manufactured stainless screens and should be properly developed. This construction will not only allow for sampling but will also allow the placement of submersible pumps of sufficient pumping capacity to conduct single-well pump tests. Estimates of hydraulic conductivity, transmissivity and flow velocity can be made as a result of the pump tests in conjunction with other ground-water data. These tests will more accurately define the site-specific hydraulic characteristics of the bases ground-water aquifer and aid in determining the direction and rate of flow of any contamination plume.

The objective of the interaquifer pump test is to observe the water levels in all wells while selected base drinking water

wells are pumped. If a water level drawdown is observed in the wells tapping the shallow unconfined aquifer while the selected base drinking water wells are pumped, then a hydraulic connection is established between the aquifers. If established, the TCE contamination would be assumed to be following the route of ground-water vertical movement.

2. Landfill No. 1, Chemical Disposal Pit Nos. 1, 2, 3 and 4 and Discharge Area No. 1 - These sites are all situated in the same general location. A geophysical survey should be conducted to determine the location of the disposal pits, any metal containers which may have been disposed in the landfills and pits, depth to hardpan as well as delineate any contaminant plumes migrating from the site. Following the geophysical survey, a ground-water monitoring program should be conducted to detect any contamination which may be emanating from this area. The program should entail the installation of three upgradient monitoring wells, four downgradient monitoring wells and two downgradient lysimeters. One upgradient and one downgradient well should penetrate the intermediate confined aquifer (>100 feet). Of the remaining two upgradient wells, one should extend below the hardpan (if it is found in the area), and the other should only extend to the top of the hardpan. Two of the three remaining downgradient wells should penetrate any hardpan in the area and the fourth should only extend to the top of the hardpan. Additionally, two lysimeters should be installed downgradient of the site. The wells and lysimeters should be sampled for the parameters in Table 6.2, List A.

   Other recommendations for this area include the expediting of the permit application to convert to a direct surface-water discharge for the industrial and domestic wastewaters and the subsequent termination of spray irrigation over Landfill No. 1.

3. Discharge Area No. 8 - This disposal area is the suspected source of the TCE contamination detected in the unconfined shallow aquifer and the intermediate confined aquifer. The

TABLE 6.2
RECOMMENDED LIST OF ANALYTICAL PARAMETERS
CASTLE AIR FORCE BASE

List A	List B
Oil & Grease	Oil & Grease
Trichloroethylene	Trichloroethylene
Phenols	Phenols
Benzene	Benzene
Methyl Ethyl Ketone (MEK)	Methyl Ethyl Ketone (MEK)
Methylene Chloride	Methylene Chloride
Total Organic Halogen	Total Organic Halogen
Total Organic Carbon (TOC)	Total Organic Carbon
pH	pH
Cadmium	Cadmium
Chromium	Chromium
Lead	Lead
Mercury	Mercury
Nitrate	Nitrate
Silver	Silver
Endrin	
Lindane	
Methoxychlor	
Toxaphene	
2,4-D	
2,4,5-TP	

study described under Item 1 of these recommendations should be extended to identify the source of the TCE contamination. The geophysical studies previously described should be conducted in the vicinity of Discharge Area No. 8 to determine if a contaminant plume can be identified. Additionally, monitoring wells extending into the shallow unconfined aquifer should be installed in areas adjacent to Discharge Area No. 8 to determine the presence and degree of contamination found in the vicinity of the site. The actual number of wells will be dependent on the results of the previous work. Wells should be sampled for TCE. Three sediment samples less than one foot from below the surface should also be collected in the ditch south of Building 1550 and analyzed for TCE.

4. Fire Protection Training Area No. 1 - This site should also be monitored to detect the presence of contamination in either the intermediate confined, unconfined or perched aquifer systems. Initially, a geophysical survey similar to the previous description should be conducted in the area. The results of the geophysical survey may dictate a more in depth monitoring program which would entail the installation of three wells. One upgradient and one downgradient well extending to the base of the unconfined aquifer, one downgradient well extending into the confined aquifer and two shallow lysimeters installed above the hardpan. The wells and lysimeters should be sampled for the parameters in Table 6.2, List B. The upgradient well may be installed after downgradient contamination is confirmed.

5. Landfill No. 5 and Chemical Disposal Pit Nos. 7, 8 and 9 - These sites are situated in the same general area. The monitoring program should be initiated after a geophysical survey to determine the location of the disposal pits, any metal containers which may have been disposed of in the landfill and pits, depth to hardpan as well as delineate any contaminant plumes migrating from the site. Following the geophysical survey, it may be

necessary to conduct additional ground-water monitoring to characterize contamination emanating from this area. The program should include the installation of one upgradient well extending to the base of the unconfined aquifer; four downgradient wells, one extending into the intermediate confined aquifer and three wells extending to the base of the unconfined aquifer; and two downgradient lysimeters installed above the hardpan, if hardpan is present in the area. The wells and lysimeters should be sampled for the parameters listed in Table 6.2, List A. The upgradient wells may be installed after downgradient contamination is confirmed. The landfill trenches have experienced differential settlement ranging from 12" to 24". The landfill should be regraded and native vegetation re-established in order to minimize future leachate generation.

6. Landfill No. 4 and Chemical Disposal Pit Nos. 5 and 6 - These sites are situated in one area, warranting a single sampling program to monitor the site. The monitoring program for this area should be initiated with a geophysical survey to determine the location of the disposal pits, any metal containers which may have been disposed of in the landfill or pits, depth to hardpan as well as delineate any contaminant plumes migrating from the site. Following the geophysical survey, it may be necessary to install monitoring wells to verify and characterize any contamination. The ground-water program may entail the installation of one upgradient and three downgradient wells extending to the base of the unconfined aquifer and one downgradient well extending into the intermediate confined aquifer. The wells should be sampled for the parameters in Table 6.2, List A. The upgradient wells may be installed after downgradient contamination is confirmed. The landfill trenches have experienced differential settlement ranging from 12" to 24". The landfill should be regraded and native vegetation re-established in order to minimize future leachate generation.

7. PCB Spill Site Nos. 1, 2, 3 - These three spill sites should be sampled to confirm whether proper clean-up actions have been

taken at the sites. One core sample of surface soil (or asphalt) taken at less than 6" depth in each area (where the spills occurred) should be collected and analyzed for PCB's.

8. Fuel Spill Nos. 1, 2, 3 and 4 - These sites are all located along the flightline area. A sampling program should be established to determine if the presence of aircraft fuel still exists in the area. Four shallow wells should be situated in downgradient locations to the hydrant system pumphouses. Two of the wells should penetrate the hardpan if it exists in the area and the remaining two wells should only extend to the upper portion of the hardpan. The wells should be analyzed for TOC, oil and grease, total organic halogen, and benzene.

9. Discharge Area Nos. 2, 3, 4, 5, 6 and 7 - These sites all have a moderate potential for environmental contamination. The following are specific recommendations for each of the sites.

Visually contaminated surface soils around Discharge Area No. 2 should be removed and a modification of the current disposal procedure should be implemented to eliminate overland discharge.

Two surface soil samples (less than 1 foot in depth) should be collected from the drainage ditch behind Discharge Area No. 3. The soil samples should be analyzed for the parameters in Table 6.2, List A. Modifications to the washrack should be implemented to prevent the direct release of any future runoff.

Two surface soil samples (less than 1 foot in depth) should be collected in the area around Discharge Area No. 4 to identify whether any TCE residuals are remaining in the soil.

Discharge Area No. 5 released several contaminants into an adjacent surface drainage ditch. Therefore, it is recommended that three sediment samples be collected from within the drainage ditch (less than 1 foot in depth). Two of the samples should be collected immediately downstream of the discharge location. The third sample should be collected very near to the

ditch outfall to Canal Creek. The samples should be analyzed for the parameters in Table 6.3, List B.

Since the State of California detected no significant concentrations of contaminants from the soil borings collected from Discharge Area No. 6, no additional sampling is recommended for this site.

Two surface soil samples (less than 1 foot in depth) should be collected from Discharge Area No. 7 to determine the presence of any residual pesticide contamination in the soil. A chlorinated hydrocarbon and organo-phosphate pesticide scan should be performed on each of the soil samples.

RECOMMENDED GUIDELINES FOR LAND USE RESTRICTIONS

It is desirable to have land use restrictions for the following reasons: (1) to provide the continued protection of human health, welfare, and the environment; (2) to insure that the migration of potential contaminants is not promoted through improper land uses; (3) to facilitate the compatible development of future USAF facilities; and (4) to allow for identification of property which may be proposed for excess or outlease.

The recommended guidelines for land use restrictions at each of the identified disposal and spill sites at Castle AFB are presented in Table 6.3. A description of the land use restriction guidelines is presented in Table 6.4. Land use restrictions at sites recommended for Phase II monitoring should be reevaluated upon the completion of the Phase II monitoring program and changes made where appropriate.

TABLE 6.3
RECOMMENDED GUIDELINES FOR FUTURE LAND USE RESTRICTIONS

Site Name	Construction	Excavation	Wells	Agriculture	Silviculture	Water Infiltration	Recreation	Burning	Disposal Operations	Vehicular Traffic	Material Storage	Housing
Landfill No. 1 Chemical Disposal Pits Nos. 1, 2 and 3	R	R	R	R	PU/R	R	R	R	PU/R	R	R	R
Landfill No. 2	R	R	R	R	R	R	R	NR	R	NR	NR	R
Landfill No. 3	R	R	R	R	R	R	R	R	R	R	NR	R
Landfill No. 4 Chemical Disposal Pit Nos. 5 and 6	R	R	R	R	R	R	R	R	R	R	R	R
Landfill No. 5 Chemical Disposal Pits No. 7, 8 and 9	R	R	R	R	R	R	R	R	R	R	R	R
Discharge Area No. 1	NR	NR	R	R	R	R	R	N/A	R	NR	R	R
Discharge Area No. 2	NR	NR	NR	N/A	N/A	N/A	R	N/A	R	NR	NR	R
Discharge Area No. 3	NR	NR	NR	N/A	N/A	N/A	R	N/A	R	NR	NR	R
Discharge Area No. 4	NR	NR	NR	N/A	N/A	N/A	R	N/A	R	NR	N/A	N/A
Discharge Area No. 5	NR	NR	NR	N/A	N/A	N/A	R	N/A	R	N/A	N/R	R
Discharge Area No. 6	R	R	R	R	R	R	R	R	R	NR	NR	R
Discharge Area No. 7	NR	NR	NR	N/A	N/A	N/A	R	N/A	R	NR	NR	R
Discharge Area No. 8	R	NR	R	N/A	N/A	N/A	R	N/A	R	N/A	R	N/A
Chemical Disposal Pit No. 4	R	R	R	R	R	R	R	R	R	NR	NR	R
Fuel Spill No. 1	NR	NR	NR	N/A	N/A	N/A	N/A	N/A	R	NR	R	R
Fuel Spill Nos. 2 and 3	NR	NR	NR	N/A	N/A	N/A	N/A	R	R	NR	NR	R
Fuel Spill No. 4	NR	NR	NR	N/A	N/A	N/A	N/A	R	R	NR	NR	R
Fire Protection Training Area No. 1	R	R	R	R	R	R	R	R	R	NR	NR	R
Fire Protection Training Area No. 2	NR	NR	N/A	N/A	N/A	NR	N/A	NR	R	NR	NR	N/A

TABLE 6.3
RECOMMENDED GUIDELINES FOR FUTURE LAND USE RESTRICTIONS
(Continued)

Site Name	Construc-tion	Excava-tion	Wells	Agricul-ture	Silvi-culture	Water Infil-tration	Recrea-tion	Burn-ing	Disposal Operations	Vehicular Traffic	Material Storage	Housing
Fire Protection Training Area No. 3	NR	NR	R	N/A	N/A	R	R	PV	R	NR	NR	R
PCB Spill Nos. 1, 2, and 3	NR	NR	NR	N/A	N/A	R	N/A	N/A	N/A	N/A	N/A	N/A
PCB Spill No. 4	NR	NR	NR	N/A	N/A	R	N/A	N/A	N/A	NR	N/A	N/A
PCB Spill No. 5	NR	NR	NR	N/A	N/A	R	N/A	N/A	N/A	NR	N/A	N/A
PCB Spill No. 6	NR	NR	NR	N/A	N/A	R	N/A	N/A	N/A	NR	N/A	N/A
PCB Spill No. 7	NR	NR	NR	N/A	N/A	R	N/A	N/A	N/A	N/A	N/A	N/A
PCB Spill No. 8	NR	NR	NR	N/A	N/A	R	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:

R = Restriction

N/A = Not Applicable

PU = Present Use

NR = No Restriction

TABLE 6.4
DESCRIPTION OF GUIDELINES FOR LAND-USE RESTRICTIONS

Guideline	Description
Construction on the site	Restrict the construction of structures which make permanent (or semi-permanent) and exclusive use of a portion of the site's surface.
Excavation	Restrict the disturbance of the cover or subsurface materials.
Well construction on or near the site	Restrict the placement of any wells (except for monitoring purposes) on or within a reasonably safe distance of the site. This distance will vary from site to site, based on prevailing soil conditions and ground-water flow.
Agricultural use	Restrict the use of the site for agricultural purposes to prevent food chain contamination.
Silvicultural use	Restrict the use of the site for silvicultural uses (root structures could disturb cover or subsurface materials).
Water infiltration	Restrict water run-on, ponding and/or irrigation of the site. Water infiltration could produce contaminated leachate.
Recreational use	Restrict the use of the site for recreational purposes.
Burning or ignition sources	Restrict any and all unnecessary sources of ignition, due to the possible presence of flammable compounds.
Disposal operations	Restrict the use of the site for waste disposal operations, whether above or below ground.
Vehicular traffic	Restrict the passage of unnecessary vehicular traffic on the site due to the presence of explosive material(s) and/or of an unstable surface.
Material storage	Restrict the storage of any and all liquid or solid materials on the site.
Housing on or near the site	Restrict the use of housing structures on or within a reasonably safe distance of the site.

APPENDIX A

BIOGRAPHICAL DATA

C. M. Mangan
M. I. Spiegel
Y. Nordhav
D. Duprey

ES ENGINEERING-SCIENCE

Biographical Data

Charles M. Mangan

Senior Environmental Engineer

PII Redacted

[redacted]

Education

B.S. in Civil Engineering, 1966, Newark College of Engineering
M.S. in Civil Engineering, 1967, New York University

Professional Affiliations

Registered Professional Engineer (Tennessee No. 11607, Georgia 7586, New Jersey No. 18366, New York No. 48280)
Diplomate - American Academy of Environmental Engineers
Water Pollution Control Federation
American Society of Civil Engineers
American Water Works Association

Honorary Affiliations

Chi Epsilon

Experience Record

1967-1970 Quirk Lawler and Matusky Engineers, New York, New York

Project Engineer. Responsible for a $400,000 water system renovation in Walton, New York. This included water main cleaning, a test well program and water main installation. In addition, supervised a surveying team and boring crew used for a stand pipe site evaluation.

As a staff engineer in the design department, participated in the design of an industrial wastewater treatment plant for Carleton Woolen Mills in Maine. Participated in various equipment evaluations prior to the writing of the required specifications.

Evaluated the installation of a centrifuge to increase the sludge dewatering capability of the municipal Bernardsville, New Jersey treatment plant which necessitated renovation of an existing building.

Charles M. Mangan (Continued)

Organized and prepared a hydrology study of the Indian Point area of West Chester County, New York for Consolidated Edison. This study was required by the Atomic Energy Commission as part of their licensing requirements for proposed nuclear reactors.

Prepared a Comprehensive Water Supply Study for Rockland County, New York. The study entailed population and water usage projections and evaluation of existing County water supplies. Various water supply projects, including a pump storage scheme were proposed and corresponding cost estimates were prepared.

Prepared computerized design of various sized domestic wastewater treatment plants for the Federal Water Quality Administration. Work consisted of the detailed sizing of various units (grit chambers, primary and secondary clarifiers, and sludge thickeners) and the preparation of detailed construction drawings.

1970-1980 Roy F. Weston Inc. West Chester, PA and Atlanta, GA

Assistant Project Engineer. Supervised current and diffusion studies off the coast of Aquadilla, Puerto Rico, and subsequently prepared a conceptual design report for a primary wastewater treatment plant and ocean outfall design.

Prepared a reference manual on various wastewater treatment processes which are applicable to the upgrading of existing treatment plants. The manual was used by EPA in their Technology Transfer program at Seminars being held for consulting engineers throughout the United States.

While working in conjunction with the Luzerne County Planning Board, prepared a solid waste regional plan to be implemented under the requirements of Pennsylvania Act 241.

Prepared an operations manual for Washington Suburban Sanitary Commission's (WSSC) 5 MGD advanced wastewater treatment plant at Piscataway, Maryland. Unit operations include 2 stage line precipitation of phosphorus, recarbonation for pH adjustment, dual media filtration and carbon adsorption for suspended and dissolved organics removal.

Charles M. Mangan (Continued)

Prepared a comprehensive water supply for WILMAPCO, a regional planning agency encompassing counties in Maryland, Delaware and New Jersey. This study was required by WILMAPCO in order to obtain certification from H.U.D. for water supply funding.

Supervised the process design for the 30 MGD advanced wastewater treatment plant to be constructed for WSSC at Piscataway, Maryland. Unit operations included two stage suspended biological growth for nitrification and denitrification, alum addition for phosphorus removal, dual media filtration and post aeration. In addition, computer facilities provide the ultimate in automation of an advanced wastewater treatment facility.

Participated in biological treatability studies and the conceptual design of two industrial wastewater treatment plants providing secondary treatment for citric acid and rayon wastewaters, respectively.

Participated on an EPA project which developed supporting information for pretreatment regulations.

Project Manager on biological treatability studies and the conceptual designs of wastewater treatment plants involving cellulose acetate, wire mill, secondary metals refining, and peanut blanching and candy manufacture.

Managed a hazardous sludge disposal study for an industry in Rome, Georgia, which included a preliminary siting study for a hazardous waste landfill.

Prepared over 5 SPCC plans for various industries throughout the Southeast for the containment of oil and hazardous wastes.

Technical consultant on a project which developed a portable treatment process capable of treating 2 million gallons of hazardous wastes from the Anniston Army Depot containing chrome, metals, phenol and large amounts of organics. Associated sludge disposal techniques included dewatering, and chemical fixation with disposal in a sanitary or secure landfill.

Conducted a program to assess phenol contamination of the groundwater table emanating from a lagoon containing wastewater.

Managed a sanitary landfill permitting project for Ft. Benning, Georgia which included multiple site evaluations, waste characterization and quantification.

Charles M. Mangan (Continued)

Project Manager on various phases of three 201 Facilities Plans for Dekalb County, GA., Valparaiso, FL. and Alapaha, GA.

Managed sewer system evaluation surveys for Knoxville, Charlotte and five other smaller communities.

1980-Date Engineering-Science, Inc. Atlanta, Georgia. Manager of Environmental Studies. Recent experience included the water permitting for a petroleum refinery expansion for Hess Oil Co. in southern Mississippi, and developmental permits including Corps Section 404 and 10, and coastal zone permits for 20,000 acres of coastal property in eastern North Carolina. Other pertinent experience includes a site assessment for a pulp and paper mill in southern Alabama and an environmental assessment for a major wastewater treatment plant expansion.

Performed a solid waste management evaluation for New Hanover County, North Carolina. Conducted hazardous waste audits on three U.S. Air Force bases to identify past chemical handling practices and the possibility of contaminant migraton off the base property.

Publications

"Aquadilla, P.R. Current and Diffusion Studies" presented at the Pollution Control Federation - Reconvened Session 1972.

"EPA Effluent Guideline Studies" presented to the Gum and Wood Chemicals Association, Atlanta, GA 1974.

"Hazardous Spill Regulations" presented to the Gum and Wood Chemicals Association. Charleston, SC 1976.

Biographical Data

MARK I. SPIEGEL

Environmental Scientist

PII Redacted

[redacted]

Education

B.S. in Environmental Health Science (Magna cum laude), 1976, University of Georgia, Athens, Georgia
Limnology and Environmental Biology, University of Florida, Gainesville, Florida
MBA Candidate, Marketing, Georgia State University

Professional Affiliations

American Water Resources Association
Technical Association of the Pulp and Paper Industry

Experience Record

1974-1976 U.S. Environmental Protection Agency, Surveillance and Analysis Division. Cooperative Student. On assignment to Air Surveillance Branch, participated in ambient air study in Natchez, Mississippi, and operated unleaded fuel sampling program for Southeast National Air Surveillance Network. For Engineering Branch, participated in NPDES compliance monitoring of industrial facilities throughout the southeast; operation and maintenance studies of municipal waste treatment facilities; and post-impoundment study of West Point Reservoir, West Point, Georgia. Participated in industrial bioassay studies for the Ecological Branch.

1977-Date Engineering-Science. Environmental Scientist. Responsible for the conduct of water and wastewater sampling programs and analyses, quality control, laboratory process evaluations, and evaluation of other environmental assessment data. Conducted leachate extraction studies of sludges produced at a large organic chemicals plant to define nature of sludges according to the Resource Recovery and Conservation Act Guidelines. Involved in laboratory quality assurance program for the analysis of water samples used in a stream modeling project. Conducted a water quality modeling study for Amerada Hess Corporation to determine the assimilative capacity of

Mark I. Spiegel (Continued)

a stream receiving effluent from a southern Mississippi refinery.

Participated in bench-scale industrial treatability studies conducted for the American Textile Manufacturers Institute and Eli Lilly Pharmaceuticals in Mayaguez, Puerto Rico, and in carbon adsorption studies for an American Cyanamid chemical plant and Union Carbide Agricultural Products Division.

Involved in various aspects of several industrial environmental impact assessments including preliminary planning for a comprehensive study for St. Regis Paper Company on a major pulp and paper mill expansion project. Assisted in preparation of third-party EIS for EPA and Mobil Chemical Company concerning a proposed 16,000-acre phosphate mining and beneficiation facility. Developed an EIA prior to construction of a pulp and paper complex by the Weyerhaeuser Company in Columbus, Mississippi, which included preparation of a separate document for the Interstate Commerce Commission concerning the construction of a railroad spur to serve the complex. Also involved in formulating the water quality, water resource and socio-economic aspects of an environmental impact assessment for International Paper Company. Participated in large scale site evaluation to determine the suitability and environmental permitting requirements of a site for an east coast brewery for the Adolph Coors Company. Participated in a study to evaluate various options for developing a large parcel of land in the coastal section of North Carolina. The study involved evaluating both the market potential and environmental constraints of various options for development such as timber harvesting, peat mining, corporate farming and aquaculture (catfish farming).

Project Manager. Conducted comprehensive process evaluation of an 80 mgd wastewater treatment system for Weyerhaeuser Company. Responsible for a study to determine the leaching characteristics of sludges for a paint manufacturing facility for RCRA compliance. Also managed study for development of a solid waste management plan for a ceramic pottery manufacturer in northern Alabama which included evaluating surface and ground-water contamination potential from the existing disposal site and assisting manufacturer in developing a disposal program acceptable to state agencies.

Mark I. Spiegel (Continued)

Participated as project team member for Phase I Installation Restoration Program projects for the Department of Defense. Studies were conducted at twelve Air Force bases to identify past hazardous waste disposal practices that could result in migration of contaminants and to recommend priority sites requiring further investigation.

Developed an Environmental Audit Manual for a pharmaceutical company. The purpose of the audit manual was to aid the company in identifying areas where a particular facility may not comply with Federal and state environmental regulations.

Biographical Data

YANE NORDHAV

Hydrogeologist

[redacted]

Education

B.A. in Political Science, 1974, University of Copenhagen
B.A. in Geology, 1976, University of California, Berkeley
M.Sc. candidate in Geology, 1983, California State University, Hayward

Professional Affiliations

Association of Engineering Geologists
Association of Environmental Professionals
Association of Women Geoscientists

Experience Record

1977-1980 Environmental Impact Planning Corporation, San Francisco, California. Geologist/Project Manager. Conducted geologic and hydrologic studies to evaluate adverse impacts of residential, commercial, and industrial developments. Responsible for evaluating effects on groundwater quality and quantity of converting 750 acres of prime agricultural land to residential use in Fresno County. Developed a water balance for the basin for existing and future conditions and estimated water quality impacts of installing septic tank systems in areas with a high water table and well-developed hardpan.

Supervised study of quantity and quality of available sand and gravel resources in Sacramento County, including an estimate of the cost-effectiveness of extraction versus importation. Conducted hydrogeologic investigation focusing on groundwater occurrence and movement, fault activity, and nature of soil material to determine suitable disposal sites for sludge generated in the San Francisco Bay area. Served as project manager for numerous environmental studies focusing on hazards from slope instability, settlement, subsidence, erosion, and flooding in California, Wyoming, and Nevada.

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Yane Nordhav (Continued)

1981-Date Engineering-Science. Hydrogeologist/Project Manager. Responsible for hydrologic and geologic investigations supporting hazardous waste investigations and water resource development and groundwater management programs in a variety of geologic and hydrologic regimes. Activities include development of drilling programs, supervision of well installation, geophysical logging, and groundwater sampling for trace metals and organic analysis. Developed and supervised drilling programs to investigate potential groundwater contamination at Edwards AFB and McClellan AFB as part of the U.S. Air Force's Installation Restoration Program - Phase II. Directed installation and sampling of groundwater monitoring wells and completion of soil borings downgradient from suspected contamination sources to determine the extent of area contamination resulting from past waste management practices of semiconductor firms. Involved in a study of past material handling practices at Drew Manufacturing Company to determine surface and subsurface distribution of trace metals and the extent of soil contamination.

Served as project manager on field investigations and preparation of environmental impact reports concerning increased discharge of wastewater treatment plant effluent to the Santa Ynez River in Santa Barbara County, development of an area subject to severe flooding in Richmond, California, and proposed gold mining operations in Napa County. Also involved in major research and field demonstration project investigating the feasibility of irrigating food crops with treated wastewater. Duties include preparing reports on studies of aerosol generation and pathogen dispersion as well as interpreting water quality and physical/chemical soils data.

Biographical Data

DANIEL R. DUPREY

Civil Engineer

PII Redacted

[redacted]

Education

B.S. in Civil Engineering, 1981, University of Santa Clara

Professional Affiliations

Engineer-in-Training Certification (California, 1980)

Honorary Affiliations

Tau Beta Pi

Experience Record

1980-1981	J&M Engineering Inc., Hayward, California. Worked as an Engineer for a pipeline construction contractor. Involved estimating, cost accounting, and site inspections. Included two months site experience as foreman for storm drain and sewer construction for the Fashion Island Shopping Center, San Mateo.
1981	E. John Finnemore, PH.D University of Santa Clara. Assisted university professor in the revision of a hydraulics/fluid mechanics test book by the expansion and correction of problem statements and solutions and by clarification of prose in the text.
1981-Date	Engineering-Science, Inc., Monterey, California.

Wrote Ranier Terrace Water Supply and Wastewater Management Study for 1,500-acre residential, commercial and industrial development in Pierce County, Washington. Involved the development and evaluation of alternative water and wastewater systems for the currently undeveloped site and the selection of apparent best alternative systems based on economic, environmental, performance and implementability factors. Included the development of projected water demands and wastewater flows, establishment of detailed design criteria for all system compenents and development of present-worth costs for each alternative.

Performed monitoring well sampling of groundwater contaminated by trichloroethane (TCE) leaked from underground storage tanks for Advanced Micro Devices and Synertech in Sunneyvale, California as part of each

Daniel R. Duprey (Continued)

company's groundwater contamination investigation and clean-up program.

Design Engineer for EPA-funded Moss Landing Sewerage Projected involving the development of plans and specifications for a wastewater collection and transmission system for the Moss Landing area consisting of sewer mains, pump stations and force mains. Participated in project, which is currently awaiting approval to award construction contract, from preliminary design through bid phase.

Assisted Project Engineer in construction phase design services for the Monterey Regional Water Pollution Control Agency (MRWPCA) fifty-million dollar regional wastewater transmission and ocean outfall system, mainly involving the review of shop drawing submittals and clarification of design intent of plans and specifications.

Wrote preliminary design report for stand-by power and remote monitoring telemetry systems for the Pebble Beach Community Services District wastewater pump stations.

Wrote operations and maintenance manual for the Monterey Effluent Pump Station which will pump all wastewater flows from Monterey and Pacific Grove to the MRWPCA regional system.

APPENDIX B

LIST OF INTERVIEWEES

APPENDIX B
LIST OF INTERVIEWEES

	Most Recent Position	Period of Service
1.	Chief Civil Engineer, 93 CES	1982-Present
2.	Acting Environmental Coordinator, 93 CES	1983-Present
3.	Base Bioenvironmental Engineer, USAF Hosp	1981-Present
4.	Bioenvironmental Engineering Staff, USAF Hosp	1982-Present
5.	Bioenvironmental Engineering Staff, USAF Hosp	1981-Present
6.	Public Affairs Officer, 93 CSG	1981-Present
7.	Internal Auditor, AF Audit Agency	1981-Present
8.	NCOIC Photo Lab, 93 CSG	1981-Present
9.	Supervisor Auto Hobby Shop, 93 CSG	1981-Present
10.	NCOIC X-Ray Lab, USAF Hosp	1979-Present
11.	NCOIC Dental Lab, USAF Hosp	1981-Present
12.	NCOIC Hospital Lab, USAF Hosp	1981-Present
13.	NCOIC Munitions Maintenance, 93 MMS	1982-Present
14.	NCO Munitions Maintenance, 93 MMS	1976-Present
15.	Real Properties Officer, 93 CES	1965-Present
16.	Supervisor Sewage Treatment Plant, 93 CES	1975-Present
17.	OIC Field Maintenance Squadron, 93 FMS	1981-Present
18.	NCOIC Corrosion Control, 93 FMS	1973-Present
19.	NCOIC, Jet Engine Shop, 93 FMS	1973-Present
20.	NCOIC Battery Shop, 93 FMS	1980-Present
21.	NCOIC AGE Shop, 93 FMS	1977-Present
22.	Asst. NCOIC Corrosion Control, 93 FMS	1981-Present
23.	Acting Supervisor Roads and Grounds, 93 CES	1973-Present

Most Recent Position	Period of Service
24. Supervisor Entomology Shop, 93 CSG	1965-Present
25. Supervisor Entomology Shop, 93 CES	1950-1982
26. Mechanical Superintendent, 93 CES	1948-Present
27. Chief Fuels Management, 93 Supp	1978-Present
28. NCOIC Exterior Electrics, 93 CES	1979-Present
29. Supervisor Power Production, 93 CES	1964-Present
30. NCOIC Vehicle Maintenance, 93 Trans	1982-Present
31. NCO Vehicle Maintenance, 93 Trans	1974-Present
32. NCOIC Operations Maintenance Sq, 93 OMS	1980-Present
33. OIC Operations Maintenance Sq, 93 OMS	1982-Present
34. NCOIC Non-Powered AGE, 93 OMS	1975-Present
35. NCOIC Trailer Maintenance, 93 MMS	1982-Present
36. NCOIC Aircraft Washrack, 93 OMS	1980-Present
37. NCOIC PMEL, 93 AMS	1981-Present
38. NCOIC Packing and Grading, 93 Supp	1983-Present
39. NCOIC Det. 1, 318 FIS	1982-Present
40. OCI, 84 FIS	1981-Present
41. NCOIC Defensive Fire Control, 93 AMS	1976-Present
42. NCOIC Aircrew Training Devices, 93 AMS	1981-Present
43. Environmental Coordinator, 93 CES	1978-1982
44. Equipment Operator, 93 CES	1941-1986
45. Equipment Operator, 93 CES	1949-1975
46. Equipment Operator, 93 CES	1943-1972
47. Equipment Operator, 93 CES	1957-1971

Most Recent Position	Period of Service
48. Fire Chief, 93 CES	1958-1975
49. Equipment Operator, 93 CES	1948-1950
50. Fire Chief, 93 CES	1982-Present
51. Firefighter, 93 CES	1952-Present
52. Equipment Operator, 93 CES	1951-1982
53. Equipment Operator, 93 CES	1967-Present
54. Equipment Operator, 93 CES	1961-1978
55. Laboratory Supervisor Sewage Treatment Plant, 93 CES	1970-Present
56. Chief Construction Management, 93 CES	1965-Present
57. Construction Inspector, 93 CES	1960-Present
58. Deputy Base Civil Engineer, 93 CES	1957-1971
59. Chief Drafting Section, 93 CES	1954-Present
60. Planning Technician, 93 CES	1981-Present
61. Chief of Planning, 93 CES	1978-Present
62. Supervisor Wastewater Treatment Plant, 93 CES	1961-1978
63. Supervisor Roads and Grounds, 93 CES	1941-1966
64. Chief Roads and Grounds, 93 CES	1949-1975
65. Safety Engineer, 93 BMW	1967-Present
66. Maintenance, 93 FMS	1942-1967
67. Maintenance, 93 FMS	1942-1979

OUTSIDE CONTACTS

Darrel Larimer Engineer	Merced Irrigation District, Merced, CA 209/722-5761
Jim Gibson Engineer	U.S. Corps of Engineers, Sacramento, CA 916/440-2541

John Sibilsky Engineer	U.S. Corps of Engineers, Flood Plain Management Group, Sacramento, CA (916)440-3550
Gil Bertoldi, Geologist Eric Swanson, Geologist	U.S. Geological Survey California District Office, Sacramento, CA (916)484-4606
R. V. Swanson Engineer	California Department of Water Resources San Joaquin District, Fresno, CA (209)445-5372
Debbie Robinson Environmental Resource Specialist	U.S. Environmental Protection Agency Region IX, San Francisco, CA 415/974-8362
Lonnie Wass Engineer	California Regional Water Quality Control Board Central Valley Region Fresno Branch Office 209/445-5116
Mohinder Sandhu Engineer	California Department of Health Services Fresno, CA 209/445-5321
Robert Ehlers Environmental Section	California Department of Fish and Game Sacramento, CA 916/445-3531
Suzanne Wall Biologist	California Natural Diversity Data Base Sacramento, CA 916/324-3816
Tom Burnham Agronomist	USDA Soil Conservation Service Los Banos, CA 209/826-5770

APPENDIX C

ORGANIZATIONS AND MISSIONS

APPENDIX C

ORGANIZATIONS AND MISSIONS

PRIMARY ORGANIZATION AND MISSION

The primary mission of the 93rd Bombardment Wing is the development and maintenance of a combat-ready force capable of conducting long-range bombardment operations as directed by the Strategic Air Command (SAC). Additionally the 93rd trains all B-52 stratofortress (G and H Series) and KC-135 stratotanker combat crews for SAC. The Wing is also responsible for operating Castle AFB and supporting the various tenant units at the base.

TENANT ORGANIZATIONS AND MISSIONS

84th Fighter Interceptor Training Squadron

The mission of the 84 FITS is to provide aircrews and aircraft in support of North American Air Defense Command (NORAD) target force requirements, E-3A crew training, weapons controller training, and F-106 target support. Provide electronic counter counter measure training, initial and continuation basic fighter maneuvering, air combat tactics lead-in training, and low level visual training. Maintain weapons storage capability in support of NORAD OPLAN 3000, operate the electronic counter measures pod maintenance facility and the joint intermediate maintenance, J-33 engine program. Unit manning is approximately 210 personnel. The type aircraft assigned is the T-33.

318th Fighter Interceptor Squadron, Det. 1

The 318 FIS, McChord AFB, Washington, maintains two F-106 Delta Darts on five minute alert at Castle AFB. The mission of the interceptors and the 27 assigned personnel is to maintain the integrity of U.S. airspace during peacetime and in the event of hostilities, to defend the Southwest.

SAC Management Engineering Team (SACMET)

The SAC Management Engineering Team has played an integral part in Castle's management support activities since its inception more than a decade ago. The team, a field extension of the Sq SAC Manpower and Organization Staff, is one of 28 SACMETs throughout the Command charged with developing, implementing, and refining controls over the Command's most costly resource - authorized manpower. The SACMET's responsibility is developing manpower standards. Other activities include validating requests for manpower and organization changes, management consultant services, contract manpower analysis, and other manpower services.

2035th Communications Squadron

The 2035th Communications Squadron is a unit of the Air Force Communications Command (AFCC) and a part of the Strategic Communications Division (SCD).

The mission of the 2035th Communications Squadron is to manage, operate and maintain communication-electronics and air traffic control systems in support of the 93rd Bombardment Wing (SAC) and the 84th Fighter Interceptor Training Squadron (TAC). This includes the maintenance of NAVAIDs, radar, radios, telephones, the operation of the base switchboard, message center, and providing combat crew communications to aircrews. The 2035th provides air traffic control service to SAC's busiest base as well as servicing ten satellite airports.

Detachment 1, 4200 Test and Evaluation Squadron

Detachment 1, 4200 TES, a direct reporting element of Headquarters Strategic Air Command Aeronautical Requirements Directorate, is responsible for supporting Aircrew Training Device acquisition programs, management of Class V modifications to existing devices, and computer systems support for digital trainers. Prime areas of responsibility include preparation of test planning documents, programming plans, test reports, and computer program updates for B-52 and KC-135 Aircrew Training devices. They provide technical support in the development of product specifications, at design reviews and during aircrew training device test activities.

Detachment 412, Air Force Audit Agency

The local Air Force Audit Agency office is a component of the Western Audit Region of the Air Force Audit Agency at McClellan AFB, CA.

The primary mission of the Air Force Audit Agency is to provide all levels of Air Force management with an independent, objective, and constructive evaluation of the effectiveness and efficiency with which managerial responsibilities are carried out.

Field Training Det. 514 (ATC)

Field Training Detachment 514 is a unit of the 37-51st Field Training Squadron at Sheppard AFB, Texas. The primary mission is to provide advance training on specific weapons systems and associated aerospace ground equipment which are related to the B-52 and KC-135 aircraft, and to provide continuous training to individuals in operational units on new equipment and new techniques. In addition, the detachment provides courses to support the primary mission of the 93rd Bomb Wing.

Det. 2, 9th Weather Squadron (MAC)

Detachment 2 is a member of the 9th Weather Squadron with headquarters at March AFB, California. Overall responsibility belongs to 3rd Weather Wing (MAC) with headquarters at Offutt AFB, Nebraska.

The detachment provides weather support around-the-clock, seven days per week. Weather conditions are constantly monitored by weather observers using modern meteorological equipment. In addition to normal crew briefings, weather forecasters can brief airborne crews via the pilot-to-metro radio. The detachment's communication equipment can provide almost instantaneous information on current weather worldwide.

Det. 1, 323 Flying Training Wing (FTC)

Detachment 1 is a sub-unit of the 323 Flying Training Wing headquartered at Mather AFB, California.

The primary mission is to operate the Accelerated Copilot Enrichment (ACE) program through use of the T-37B aircraft. The overall objective of the ACE program is to provide increased flying opportunities for younger pilots, strengthen their self confidence and increase their opportunities to develop decision making skills. In addition, the program gives copilots more flying experience and the maturity that is essential in preparation for the assumption of aircraft commander responsibilities.

APPENDIX D

MASTER LIST OF SHOPS

APPENDIX D

MASTER LIST OF SHOPS

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Treatment, Storage and Disposal Methods
93rd Operations Maintenance Squadron (OMS)				
Non-Powered AGE	1319	Yes	Yes	Taken to POL for contractor recycle.
Non-Powered AGE Washrack	Hardstand No. 6	No	No	Rinse water and cleaning agents discharged to surface soils adjacent to washrack.
Aircraft Washrack	1521	Yes	Yes	Rinse water and cleaning agents discharged to separator system. Oils stored in adjacent tank for contractor removal. Water pumped to industrial sewer. Separator has been bypassed on occasion and wastes were discharged directly to surface drainage.
93rd Transportation Squadron				
Vehicle Maintenance	325	Yes	Yes	Floor drains to oil/water separator disposed by contractor. Solvents disposed by contractor.

APPENDIX D
MASTER LIST OF SHOPS
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Treatment, Storage and Disposal Methods
93rd Transportation Squadron (Continued)				
Battery Shop	325	Yes	Yes	Acid neutralized prior to discharge to sanitary sewer.
Fire Truck Maintenance	1344	Yes	Yes	Oils and solvents disposed by contractor.
Refueling Vehicle Maintenance	59	Yes	Yes	Oils and solvent disposed by contractor.
93rd Supply Squadron (SS)				
Liquid Oxygen Plant	1314	No	No	Past solvents disposed on ground surface adjacent to plant.
Fuels Lab	508	Yes	No	Fuels used for analysis are recycled or discharged to sanitary sewer.
93rd Combat Support Group (CSG)				
Auto Hobby Shop	551	Yes	Yes	Waste oils to POL storage for contractor disposal.

APPENDIX D
MASTER LIST OF SHOPS
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Treatment, Storage and Disposal Methods
93rd Combat Support Group (CSG) (Continued)				
Combat Arms Training	1882	Yes	No	--
Photo Lab	84	Yes	Yes	Silver recovery prior to discharge to sanitary sewer.
93rd Civil Engineering Squadron (CES)				
Fire Extinguisher Maintenance	1344	No	No	--
Heating Shop	541	Yes	Yes	Asbestos disposed in plastic bags in sanitary landfill.
Sheet Metal	541	Yes	No	--
Carpentry	547	Yes	No	--
Plumbing	547	Yes	No	--
Refrigeration	547	Yes	No	--
Exterior Electric	851	Yes	Yes	Transformers containing PCB stored in PCB storage awaiting off-base disposal.

APPENDIX D
MASTER LIST OF SHOPS
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Treatment, Storage and Disposal Methods
93rd Civil Engineering Squadron (CES) (Continued)				
Power Production	951	Yes	Yes	Fuel to POL for contractor disposal. Acid neutralized and discharged.
Entomology	917	Yes	Yes	Containers triple rinsed, crushed, stored in drains for disposal. Rinse water to evaporation pond.
Pavement and Grounds	850	Yes	Yes	--
Paint Shop	547	Yes	No	--
Liquid Fuels Maintenance	545	Yes	Yes	Fuel sludge burned in fire training area; fuel filters to hazardous waste storage area.
Equipment Maintenance	545	Yes	Yes	Used oil to POL storage tank for contract disposal.

APPENDIX D
MASTER LIST OF SHOPS
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Treatment, Storage and Disposal Methods
93rd Avionics Maintenance Squadron (AMS)				
Auto Pilot	1335	Yes	No	--
Instrument	1335	Yes	No	--
Bomb	1335	Yes	No	--
Defensive Fire Control	1335	Yes	Yes	Waste solvents and oils emulsified to hazardous waste storage area.
Photo Lab	1335	Yes	Yes	Silver recovery prior to discharge to sanitary sewer.
Radio	1335	Yes	No	--
Radar	1335	Yes	No	--
Doppler	1335	Yes	No	--
Electronic Counter-measures (ECM)	1335	Yes	Yes	Waste solvents disposed in flightline bowsers.
PMEL	1532	Yes	Yes	Mercury recycled.

APPENDIX D
MASTER LIST OF SHOPS
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Treatment, Storage and Disposal Methods
93rd Avionics Maintenance Squadron (AMS) (Continued)				
Aircrew Training Devices	175	Yes	Yes	Waste hydraulic fluid taken to POL storage for contract disposal.
93rd Munitions Maintenance Squadron (MMS)				
Special Weapons Maintenance	1709	Yes	Yes	Small quantities of solvent placed in flammable storage containers; stored for contract disposal.
Conventional Weapons Maintenance	1709	Yes	Yes	Small quantities of solvent placed in flammable storage containers; stored for contract disposal.
Weapons Loading and Release	1319	No	No	--
Trailer Maintenance	1404	Yes	Yes	Waste oils and solvents delivered to U/G POL storage tank for contract disposal.
SRAM A/C Checkout	1319	Yes	Yes	Waste solvent delivered to U/G POL storage tank for contract disposal.

APPENDIX D
MASTER LIST OF SHOPS
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Treatment, Storage and Disposal Methods
93rd Field Maintenance Squadron (FMS)				
Electric	1350	Yes	Yes	Waste oils to POL storage tank for contract disposal.
Egress	1350	Yes	No	--
Fuel Systems Repair	Flightline	Yes	Yes	Contaminated fuel burned at fire training area.
Pneudraulics	1350	Yes	Yes	To POL U/G storage tank for contract disposal.
Brake	1350	Yes	Yes	Waste solvents to hazardous waste storage area.
Repair and Reclamation	1350	Yes	Yes	Waste oils and hydraulic fluid to POL U/G storage area. Waste solvents and stripper to Wheel and Tire Shop.
Wheel and Tire	1350	Yes	Yes	Solvents and stripper to hazardous waste storage area.
Test Cell	949	Yes	Yes	Fuel oils and solvents cleaned up with speedy-dry. Past - wastes were washed onto the adjacent ground surface.

APPENDIX D
MASTER LIST OF SHOPS
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Treatment, Storage and Disposal Methods
93rd Field Maintenance Squadron (FMS) (Continued)				
CSD Shop (small turbine engines)	1260	Yes	Yes	Waste oils to POL U/G storage area for contract disposal.
Engine Conditioning	1260	No	No	--
Stanl Maintenance	1260	Yes	No	--
Jet Engine Intermediate Maintenance	1260	Yes	Yes	Fuels to fire training area. Oils to POL storage for contract disposal. Solvents to industrial sewer.
AGE	1325	Yes	Yes	Oils and solvents to adjacent U/G storage tank pumped for contract disposal.
Corrosion Control	1253	Yes	Yes	Waste paints and stripper to hazardous waste storage area.
Structural Repair	1253	Yes	No	--
Metals Processing	1253	Yes	Yes	Waste oil to POL for contract disposal.
Machine Shop	1253	Yes	No	--

APPENDIX D
MASTER LIST OF SHOPS
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Treatment, Storage and Disposal Methods
93rd Field Maintenance Squadron (FMS) (Continued)				
NDI	1532	Yes	Yes	Penetrant and emulsifier to hazardous waste storage area.
Survival Equipment	46	No	No	--
Battery Shop	1405	Yes	Yes	Neutralized prior to disposal in sanitary sewer.
Environmental Systems	1350	Yes	No	--
93rd Bombardment Wing (BMW)				
Aircrew Life Support	1213	Yes	No	--
USAF Hospital				
Laboratory	1192	Yes	No	--
Dental Clinic and Lab	1182	Yes	No	--
Dental Clinic X-Ray	1182	Yes	Yes	Silver recovery prior to discharge to sanitary sewer.

APPENDIX D
MASTER LIST OF SHOPS
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Treatment, Storage and Disposal Methods
USAF Hospital (Continued)				
Medical X-Ray	1182	Yes	Yes	Silver recovery prior to discharge to sanitary sewer.
Surgery	1182	Yes	Yes	Pathological wastes disposed in incinerator.
2035th Communications Squadron (CS)				
Navigational Aids	1330	No	No	--
Radar Maintenance	1340	No	No	--
Inter-Base Radio	1330	No	No	--
ATC Radio	1340	No	No	--
84th Fighter Interceptor Training Squadron (FITS)				
Welding Shop	1550	No	No	--
Corrosion Control	1541	Yes	Yes	Solvents and thinner to hazardous waste storage area.

APPENDIX D
MASTER LIST OF SHOPS
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Treatment, Storage and Disposal Methods
84th Fighter Interceptor Training Squadron (FITS) (Continued)				
Sheet Metal	1550	No	No	--
Electronic Counter Measures	1550	Yes	No	--
Jet Engine Intermediate Maintenance	1260	Yes	Yes	Acid neutralized prior to discharge in sanitary sewer. Solvents and oils collected and stored at POL U/G storage tank for contract disposal.
AGE	1562	Yes	Yes	Oil water separator. Oils collected for contract disposal. Water pumped to industrial sewer. Waste oil delivered to POL for contract disposal.
Air Maintenance Shop	1762	Yes	Yes	Waste petroleum products delivered to POL for contract disposal. Waste solvents to industrial sewer.
Engine Test Cell	950	Yes	Yes	Waste petroleum products and solvents delivered to POL storage area for contract disposal.

APPENDIX D
MASTER LIST OF SHOPS
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Treatment, Storage and Disposal Methods
84th Fighter Interceptor Training Squadron (FITS) (Continued)				
Specialist Flight	1555	No	No	--
Egress Shop	1550	Yes	No	--
Det 1, 318th Fighter Interceptor Squadron (FIS)				
Det 1, 318th FIS	1550/1560	Yes	Yes	Contaminated fuel reclaimed.

APPENDIX E

CASTLE AIR FORCE BASE
AND SELECTED MERCED
IRRIGATION DISTRICT WELL LOGS

J. H. KLEINFELDER & ASSOCIATES
GEOTECHNICAL CONSULTANTS — MATERIALS TESTING

BORING LOG

HOLE NO.	PROJECT NO.	PROJECT	SHEET 1 OF 7
Well 12	81-0623	Water Sampling Wells	

MFG. DESIGNATION OF DRILL: Acker AD-II
LOCATION: Castle AFB
TYPE OF BIT:
HAMMER DATA: WT. LBS. DROP INCHES
ELEV:
TOTAL DEPTH OF HOLE: 100'
DATE STARTED:
DATE COMPLETED:
DATE BACKFILLED:
DRILLING AGENCY: J. H. Kleinfelder & Assoc.
INSPECTOR:
CREW:
GROUNDWATER DEPTH: TIME:
SURFACE CONDITIONS:

DIST. FROM SURF.	LEGEND	SAMPLE TYPE	SAMPLE NO.	RECOVERY	BLOWS PER 6 IN.	USCS	LOG OF MATERIAL
0–20						SM	SM Silty Sand.
20–30						SC	SC Clayey Sand.
30–45						SM	SM Silty Sand.
45–70						SP	SP Clean Fine to Medium Sand.
70–90						SM	SM Gravel.
90–94	Well Screen					SP	SP Fine Sand.
94–100						CL	CL Clay.
100							Pump at Bottom of Well Screen
105							

SHEET ____ OF ____ HOLE NO. ____

J. H. KLEINFELDER & ASSOCIATES
GEOTECHNICAL CONSULTANTS — MATERIALS TESTING

BORING LOG

HOLE NO.	PROJECT NO.	PROJECT	SHEET 2 OF 7
Well 13	81-0623	Water Sampling Wells	

MFG. DESIGNATION OF DRILL	LOCATION
Acker AD-II	Castle AFB

TYPE OF BIT	HAMMER DATA: WT. LBS. DROP INCHES	ELEV	TOTAL DEPTH OF HOLE
			95'

DATE			
STARTED		DRILLING AGENCY	J. H. Kleinfelder & Assoc.
COMPLETED		INSPECTOR	
BACKFILLED		CREW	

SURFACE CONDITIONS

GROUNDWATER DEPTH TIME

DIST. FROM SURF.	LEGEND	SAMPLE TYPE	SAMPLE NO.	RECOVERY	BLOWS PER 6 IN.	USCS	LOG OF MATERIAL
0						SM	SM Silty Sand.
5							
10							
15							
20							
25							
30							
35							
40							
45							
50							
55						CL	CL Clay.
60							
65						SM	SM Silty Sand.
70						GM	GM Gravel.
75							
80						SP	SP Sand.
85		Well Screen					
90						CL	CL Clay.
95							Pump at Bottom of Well Screen.
100							
105							

SHEET OF HOLE NO.

J. H. KLEINFEL[illegible]R & ASSOCIATES
GEOTECHNICAL CONSULTANTS — MATERIALS TESTING

BORING LOG

HOLE NO.	PROJECT NO.	PROJECT	SHEET 3 OF 7
Well 14	81-0623	Water Sampling Wells	

MFG. DESIGNATION OF DRILL	LOCATION
Acker AD-II	Castle AFB

TYPE OF BIT	HAMMER DATA: WT. LBS. DROP INCHES	ELEV.	TOTAL DEPTH OF HOLE
DATE STARTED	DRILLING AGENCY J. H. Kleinfelder & Assoc.		95'
DATE COMPLETED	INSPECTOR	GROUNDWATER DEPTH	TIME
DATE BACKFILLED	CREW		
SURFACE CONDITIONS			

DIST. FROM SURF.	LEGEND	SAMPLE TYPE	SAMPLE NO.	RECOVERY	BLOWS PER 6 IN.	USCS	LOG OF MATERIAL
0						SM	SM Silty Sand.
30						CL	CL Sandy Clay.
45						SP	SP Fine to Medium Sand.
70						GM	GM Gravel.
82–90	Well Screen						
90						CL	CL Sandy Clay.
92						CL	CL Clay.
95							Pump at Bottom of Well Screek

SHEET OF HOLE NO.

J. H. KLEINFEL R & ASSOCIATES
GEOTECHNICAL CONSULTANTS — MATERIALS TESTING

BORING LOG

HOLE NO.	PROJECT NO.	PROJECT	SHEET 4 OF 7
Well 15	81-0623	Water Sampling Wells	

MFG. DESIGNATION OF DRILL	LOCATION
Acker AD-II	Castle AFB

TYPE OF BIT	HAMMER DATA: WT. LBS. DROP INCHES	ELEV.	TOTAL DEPTH OF HOLE
			90'

DATE			
STARTED		DRILLING AGENCY	J. H. Kleinfelder & Assoc.
COMPLETED		INSPECTOR	
BACKFILLED		CREW	

GROUNDWATER DEPTH TIME

SURFACE CONDITIONS

DIST. FROM SURF.	LEGEND	SAMPLE TYPE	SAMPLE NO.	RECOVERY	BLOWS PER 6 IN.	USCS	LOG OF MATERIAL
0							SM Very-Silty Fine Sand.
5							
10							
15							
20							
25							
30							
35							
40							
45							
50							
55							
60							
65							
70							
75		Well Screen					GM Gravel.
80							
85							CL Clay.
90							Pump at Bottom of Well Screen.
95							
100							
105							

SHEET OF HOLE NO.

J. H. KLEINFELDER & ASSOCIATES

GEOTECHNICAL CONSULTANTS — MATERIALS TESTING

BORING LOG

HOLE NO.	PROJECT NO.	PROJECT	SHEET 5 OF 7
Well 16 / Add-I	81-0623	Water Sampling Wells	

MFG. DESIGNATION OF DRILL	LOCATION
Acker AD-II	Castle AFB

TYPE OF BIT	HAMMER DATA: WT. LBS. DROP INCHES	ELEV.	TOTAL DEPTH OF HOLE
			102'

DATE			
STARTED		DRILLING AGENCY	J. H. Kleinfelder & Assoc.
COMPLETED		INSPECTOR	
BACKFILLED		CREW	

GROUNDWATER DEPTH — TIME

SURFACE CONDITIONS

DIST. FROM SURF.	LEGEND	SAMPLE TYPE	SAMPLE NO.	RECOVERY	BLOWS PER 6 IN.	USCS	LOG OF MATERIAL
0						SM	SM Silty Sand.
5							
10							
15							
20							
25							
30							
35							
40							
45							
50							
55							
60						GM	GM Gravel.
65							
70							
75							
80							
85						SP	SP Fine to Medium Sand.
90							
95		Well Screen				CL	CL Sandy Clay.
100							
105							Pump at Bottom of Well Screen.

SHEET OF HOLE NO.

J. H. KLEINFELDER & ASSOCIATES
GEOTECHNICAL CONSULTANTS — MATERIALS TESTING

BORING LOG

HOLE NO.	PROJECT NO.	PROJECT	SHEET 6 OF 7
Well 17 / Add-2	81-0623	Water Sampling Wells	

MFG. DESIGNATION OF DRILL	LOCATION
Acker AD-II	Castle AFB

TYPE OF BIT	HAMMER DATA: WT. LBS. DROP INCHES	ELEV.	TOTAL DEPTH OF HOLE
			100'

DATE			
STARTED		DRILLING AGENCY	J. H. Kleinfelder & Assoc
COMPLETED		INSPECTOR	GROUNDWATER DEPTH / TIME
BACKFILLED		CREW	
SURFACE CONDITIONS			

DIST. FROM SURF.	LEGEND	SAMPLE TYPE	SAMPLE NO.	RECOVERY	BLOWS PER 6 IN.	USCS	LOG OF MATERIAL
0						SM	Silty Fine to Medium Sand.
5							
10							
15							
20							
25							
30							
35							
40							
45							
50							
55							
60							
65							
70						GM	Gravel.
75							
80							
85						ML	Fine Sandy Silt.
90							
95		Well Screen					
100						CL	Clay.
105							Pump at Bottom of Well Screen.

SHEET OF HOLE NO.

J. H. KLEINFEL R & ASSOCIATES
GEOTECHNICAL CONSULTANTS — MATERIALS TESTING

BORING LOG

HOLE NO.	PROJECT NO.	PROJECT	SHEET 7 OF 7
Well 18 / Add 3	81-0623	Water Sampling Wells	

MFG. DESIGNATION OF DRILL	LOCATION
Acker AD-II	Castle AFB

TYPE OF BIT | HAMMER DATA: WT. LBS. DROP INCHES | ELEV | TOTAL DEPTH OF HOLE: 95'

DATE: STARTED / COMPLETED / BACKFILLED

DRILLING AGENCY: J. H. Kleinfelder & Assoc.

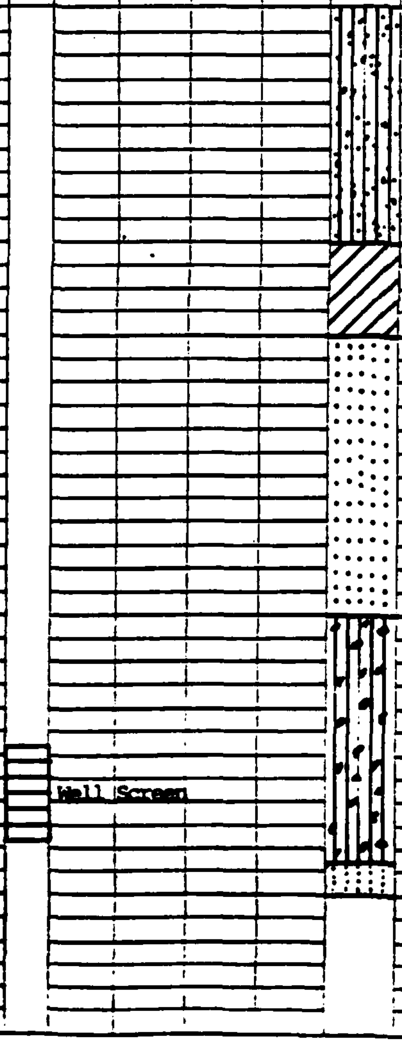
INSPECTOR

CREW

GROUNDWATER DEPTH | TIME

SURFACE CONDITIONS

DIST. FROM SURF.	LEGEND	SAMPLE TYPE	SAMPLE NO.	RECOVERY	BLOWS PER 6 IN.	USCS	LOG OF MATERIAL
0–25						SM	SM Silty Sand.
25–35						CL	CL Clay.
35–65						SP	SP Sand.
65–92						GM	GM Gravel.
80–90		Well Screen					
92–95						SP	SP Sand.
100							Pump at Bottom of Well Screen.
105							



SHEET OF

TRIPLICATE
Retain this copy

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, 7079, Water Code)

THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

Do Not Fill In
Nº 29635
State Well No.
Other Well No.

(1) OWNER:
Name Merced Irrigation District
Address 2123 L Street
Merced, California

(2) LOCATION OF WELL:
County Merced Owner's number, if any 7-B
Township, Range, and Section
Distance from cities, roads, railroads, etc. 1/4 mile west of Bobach
75' south of Ave. 2

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Destroying ☐
If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(5) EQUIPMENT:
Rotary ☒
Cable ☐
Other ☐

(6) CASING INSTALLED:
STEEL: OTHER:
SINGLE ☒ DOUBLE ☐

If gravel packed

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	From ft.	To ft.
0	236	16"	#8	28"		

Size of shoe or well ring: Cone
Describe joint: Collar
Size of gravel: Well sand & 3/8 pea gravel mixed

(7) PERFORATIONS OR SCREEN:
Type of perforation or name of screen Factory cleancut

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
68	236	32	4	1½" x 1/8"

(8) CONSTRUCTION:
Was a surface sanitary seal provided? Yes ☐ No ☒ To what depth ft.
Were any strata sealed against pollution? Yes ☐ No ☒ If yes, note depth of strata
From ft. to ft.
From ft. to ft.
Method of sealing

(9) WATER LEVELS:
Depth at which water was first found, if known 36 ft.
Standing level before perforating, if known ft.
Standing level after perforating and developing ft.

(10) WELL TESTS:
Was pump test made? Yes ☐ No ☐ If yes, by whom?
gal./min. with ft. drawdown after hrs.
Temperature of water Was a chemical analysis made? Yes ☐ No ☒
Was electric log made of well? Yes ☐ No ☒ If yes, attach copy

(11) WELL LOG:
Total depth 240 ft. Depth of completed well ~~240~~ 236 ft.
Formation: Describe by color, character, size of material, and structure

ft. to	ft.	
0	7	Sand
7	15	Hard sandy clay
15	19	Red sand
19	23	Hardpan
23	25	Hard sandy clay
25	31	Brown clay
31	82	Medium to coarse sand
82	89	Gray clay
89	92	Medium fine gray sand
92	95	Gray clay
95	99	Medium brown sand
99	100	Brown sandy clay
100	110	Medium brown sand
110	111	Brown sandy clay
111	120	Medium brown sand
120	124	Brown clay
124	125	Brown medium sand
125	129	Brown clay
129	130	Fine sand
130	138	Brown clay
138	142	Medium brown sand
142	146	Brown clay
146	148	Medium sand
148	150	Gray clay
150	156	Medium gray sand
156	169	Gray clay
169	170	Coarse sand
170	174	Pink clay
174	176	Sandy brown clay
176	191	Coarse sand and gravel
191	198	Gray clay
198	204	Medium gray sand
204	207	Brown clay
207	208	Coarse sand
208	218	Gray clay
218	240	Sand and cobbles

Work started 1/23/67 19 , Completed 2/1/67 19

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Bill Belkman BH
(Person, firm, or corporation) (Typed or printed)
Address 9274 So. Buttonwillow Ave.
Reedley, California 93654
[Signed] Bill Belkman vh
(Well Driller)
License No. 106833 Dated 2/3/67 , 19

SKETCH LOCATION OF WELL ON REVERSE SIDE

DWR 188 (REV. 6-65)

WELL No. 6

Location: $E\frac{1}{2}$ of $SE\frac{1}{4}$ of Section 5-7-13.

Drilled by: R.A.Hoffman
Nov. 1 - 15, 1923.

Depth to water: 9 feet.

0 to $4\frac{1}{2}$	Sand	Casing: 50 ft. of 20"
$4\frac{1}{2}$ to $6\frac{1}{2}$	Hardpan	
6 to 17	Clay	G.P.M.: 1,300
17 to 39	Sand	
39 to 68	Clay	Draw-
68 to $83\frac{1}{2}$	Gravel and boulders	down: 30 feet.

MOTOR:

General Electric Induction Motor, Model No. 4378.
Type K. T. 322 - 6 - 25 - 1200
Form: A
Volt: 440
Amp: 28.5
No. 4014969
Full load speed 1,160
3 phase, 60 cycle
H.P. 25 50° C

Cost, Pump, $921.00

PUMP:

Byron Jackson - Built on Order No. 78198.
#6 L. C. Deepwell Turbine Pump to deliver 1,300 G.P.M. at 47 ft. Total head.
1 length 10" Suction and Strainer over-all to be 5'.
#3 Pump Head complete with 10" discharge and companion flange bolted to same, fitted to Motor (Above)
1 Automatic Lubricator with solenoids for 440 volt circuit.
Col: 42 feet of 10" x $2\frac{1}{2}$" x 1 11/16" Column.
Eff: 69%
Type: D.W.
Date: 12-20-23
Cap.: 1,300 G.P.M. Total head 47 feet.
R.P.M.: 1,200.

Notes- New Pump installed Spring, 1929.
Pump Test #2058

SAN JOAQUIN LIGHT & POWER CO. METER NO. 92970.

New Pump
Notes- Spring, 1929

(#8A.M., 2 Stage @ 860 R.P.M.
(will give 73 % pump Eff.
(Add 1.5 Col. for 10"
(0.5 H.P. Add. for Shaft
(15 H.P. Motor @ 860 R.P.M.
(1,000 G.P.M. on 42 feet.

IRRIGATION WELL #34
Location: SW¼ of SW¼ Section 31-6-13
Drilled by J. W. Livermore - 1922

0 -	6	Soil	
6 -	9	Hard Pan	51 ft. 24" Casing
9 -	25	Hard Pan	
25 -	58	Clay & Hard Pan	
58 -	78	Clay & Hard Pan	
78 -	84	Water Sand	

MOTOR

General Electric
25 HP - 440 volts
1150 RPM

Byron Jackson Head
10" Discharge Head
60 ft. 10" I.D. Col. x 1-3/16 Shafting & 2½" Tubing
1 - 2 stage 14" Berkeley Bowl

STARTER

General Electric 440 volts

New Col. Tubing & Bowls - 1959
Motor & Head from old pump

W. O. 2162

WELL NO. 34-A

Atwater District NW¼ of Section 6-7-13

Drilled by M. I.D. December 1940

0 - 5	Soil	54' of 18" #14 Ga. Double Casing
5 - 8	Hardpan	Perf. 3/16" x 1" C.C.
8 - 25	Sand	
25 - 34	Red Sand	1 Steel Shoe
34 - 37	Hard Sand	
37 - 47	Sand	
47 - 60	Clay	
60 - 80	Hard Sand	
80 - 96	Sandy Clay	Well Developed 2000 G.P.M. 35' D.D.

Motor - 40 H.P. 3 ø 440 Volts 1160 R.P.M. Westinghouse

Pump - Pomona 5 H.P. Head 12" O.D. Discharge #H3P611C-1

40' 120D x 1-13/16 Column and shaft

2 Stage #16" M.C.

Starter - Westinghouse Outdoor Pump Plant Panel

Motor Hood and steel stand

WELL NO. 70

Location: Barker Ranch Lot 20, Section 31-6-13

Drilled By: Osterberg Bros., March 17, 1928.

Depth to Water:

0	to	9	Top Soil
9	to	28	Hardpan
28	to	40	Sand
40	to	43	Clay
43	to	50	Sand
50	to	62	Clay
62	to	78	Gravel
78	to	93	Hardpan
		93	Sand

Well - 18" Open Bottom

Casing - Perforated.

18" Landed at 51 Feet
16" " " 81 "
16" Out off 45 "

1620 G.P.M. @ 46 ft. Total Head.
4.0 Feet Depth to Static Water.
27.0 Feet - Drawdown.
Eff. 75%

MOTOR:

25 H.P. Byron-Jackson - G.E.
900 R.P.M.
440 Volts, 3 Phase, 60 Cycle, Vertical Shaft.
G.E. Automatic Starter.

PUMP: #100924

No. 6 AL - 2 Stage Deep Well (17 3/8" O.D.)
Built-In Motor
Suction - 18' of 10" O.D.
Column - 42' of 12" O.D.
Shaft - 1 11/16" dia. Shaft Tubing - 2½" dia.

Cost of Pump & Motor:

Dec. 6, 1977 New pump 30 H.P. Landed @ 81'
Bowl Setting @ 70' + 5' Suction - 8" Column

WELL NO. 225-P

Location: 157' S. to Bellevue Ave. 1365' E. to Franklin Rd.

Drilled by: Bill Belknap

0' to 1'	Red soil		
1' to 4'	Hardpan		
4' to 11'	Hard red clay		
11' to 15'	Sandy clay		
15' to 21'	Sand	April 19, 1965	
21' to 68'	Gray clay		
68' to 82'	Dirty sand	Casing - 124 Ft.	
82' to 99'	Hard clay	Depth - 171 Ft.	
99' to 103'	Coarse gray sand		
103' to 110'	Red sandy clay		
110' to 116'	Red silty sand		
116' to 158'	Red clay		
158' to 171'	Red sand		

Developed:

2500	G.P.M.	96 Ft.
2200	G.P.M.	93 Ft.
1800	G.P.M.	89 Ft.
1600	G.P.M.	86 Ft.

Static Water: 26 Ft.

Motor: U.S. - 60 HP - Vertical Hollow Shaft
440 Volts - 3 phase - 60 cycle - 1770 RPM
10" Standard Discharge

Pump: Byron Jackson - 1 stage
Oil Lubricated
Section Length 20 Feet
10 Feet 10" suction
Pump setting 110'
Impeller No. CG Bowl 14" CGH

WELL NO. 226-P

Location: 36' S. to Bellevue Ave. 1260' E. to Fox

Drilled by: Bill Belknap

0' to 2'	Top soil	
2' to 6'	Hardpan	
6' to 15'	Red clay	
15' to 46'	Sandy clay	
46' to 57'	Gray clay	
57' to 61'	Sand	
61' to 63'	Gray clay	
63' to 69'	Gray sand (Med.)	April 27, 1965
69' to 84'	Sandy clay	
84' to 90'	Medium sand	Casing - 144 Ft.
90' to 97'	Red clay	Depth - 206 Ft.
97' to 114'	Hard clay	
114' to 126'	Joint clay	
126' to 140'	Brown sandy clay	
140' to 158'	Red clay	
158' to 160'	Fine red sand	
160' to 168'	Gray clay	
168' to 172'	Brown clay	
172' to 175'	Sandy clay	
175' to 197'	Hard clay	
197' to 206'	Coarse sand	

Developed:

2500	G.P.M.	90 Ft.
2200	G.P.M.	87 Ft.
1800	G.P.M.	84 Ft.
1600	G.P.M.	81 Ft.

Static Water: 27 Ft.

Motor:
U.S. 75 HP - Vertical Hollow Shaft
440 Volts - 3 phase - 60 cycle - 1770 RPM
10" Standard Discharge

Pump:
Byron Jackson - 2 stage
Oil Lubricated
Section Length 20 feet
10 Feet 10" suction
Pump setting 110'
Impeller No. 3   Bowl 14" 3RLc

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WATER WELL DRILLERS REPORT

(Sections 7079, 7080, 7081, 082, Water Code)

THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

Do Not Fill In

Nº 21554

State Well No.

Other Well No.

(1) OWNER:
Name Merced Irrigation District
Address 2023 "L" Street
Merced, California

(2) LOCATION OF WELL:
County Merced Owner's number, if any 227 P
Township, Range, and Section
Distance from cities, roads, railroads, etc. 400 feet South to Ave. 2
106 feet Northeast to Santa Fe R.R.

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Destroying ☐
If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(5) EQUIPMENT:
Rotary ☐
Cable ☒
Other ☐

(6) CASING INSTALLED:
STEEL: ☒ OTHER:
SINGLE ☒ DOUBLE ☐

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	From ft.	To ft.
0	144	16	8			

If gravel packed

Size of shoe or well ring 10 x 3/4 Size of gravel
Describe joint Buttwelded

(7) PERFORATIONS OR SCREEN:
Type of perforation or name of screen [illegible] none

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.

(8) CONSTRUCTION:
Was a surface sanitary seal provided? Yes ☐ No ☒ To what depth ft.
Were any strata sealed against pollution? Yes ☐ No ☒ If yes, note depth of strata
From ft. to ft.
From ft. to ft.
Method of sealing

(9) WATER LEVELS:
Depth at which water was first found, if known 30 ft.
Standing level before perforating, if known ft.
Standing level after perforating and developing ft.

(10) WELL TESTS:
Was pump test made? Yes ☒ No ☐ If yes, by whom? Bellcomp
Yield: 2500 gal./min. with 11 from 83 ft. drawdown after hrs.
Temperature of water Was a chemical analysis made? Yes ☐ No ☒
Was electric log made of well? Yes ☐ No ☒ If yes, attach copy

(11) WELL LOG:
Total depth 188 ft. Depth of completed well 188 ft.
Formation: Describe by color, character, size of material, and structure

ft. to	ft.	
0	8	Sandy
8	12	Brown clay
12	15	Hard pan
15	20	Brown sand
20	28	Brown clay
28	36	Coarse sand
36	44	Red clay
44	56	Grey clay
56	72	Sandy clay
72	89	Sand & cobbles
89	94	Sandy clay
94	105	Red clay
105	109	Joint clay
109	112	Sandy clay
112	119	Grey clay
119	126	Sandy clay
126	137	Joint clay
137	164	Red clay
164	168	Red sand
168	175	Sandy clay
175	178	Coarse sand
178	184	Sandy clay
184	188	Brown sand

Work started 12-8 19 65 Completed 12-13, 19 65

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Bill Bellcomp Well Drilling
(Person, firm, or corporation) (Typed or printed)
Address 9274 So. Buttonwillow Ave.
Reedley, California
[SIGNED]
(Well Driller)
License No. 106835 Dated 7-11 19 66

SKETCH LOCATION OF WELL ON REVERSE SIDE

DWR 88

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WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, 7079, Water Code)

THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

Do Not Fill In
№ 21885 #21885

State Well No. ____
Other Well No. ____

(1) OWNER:
Name: Merced Irrigation District
Address: 2423 L Street
Merced, California

(2) LOCATION OF WELL:
County: Merced   Owner's number, if any: 228P
Township, Range, and Section:
Distance from cities, roads, railroads, etc.: 25' south to Livingston Canal; 1660' west to Bubach Road

(3) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Destroying ☐
If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(5) EQUIPMENT:
Rotary ☐
Cable ☒
Other ☐

(6) CASING INSTALLED:
STEEL: SINGLE ☒ DOUBLE ☐ OTHER:

If gravel packed

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	From ft.	To ft.
0	224	16"	#8			

Size of shoe or well ring: 16"x10"x3/4" steel shoe
Describe joint: Buttwelded

(7) PERFORATIONS OR SCREEN:
Type of perforation or name of screen: Mills

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
174	182	8"	2	3" x 3/8"

(8) CONSTRUCTION:
Was a surface sanitary seal provided? Yes ☐ No ☒ To what depth ____ ft.
Were any strata sealed against pollution? Yes ☐ No ☒ If yes, note depth of strata
From ____ ft. to ____ ft.
From ____ ft. to ____ ft.
Method of sealing

(9) WATER LEVELS:
Depth at which water was first found, if known: 27 ft.
Standing level before perforating, if known: ____ ft.
Standing level after perforating and developing: ____ ft.

(10) WELL TESTS:
Was a pump test made? Yes ☒ No ☐ If yes, by whom? Belknap
Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.
Temperature of water ____ Was a chemical analysis made? Yes ☐ No ☒
Was electric log made of well? Yes ☐ No ☒ If yes, attach copy

(11) WELL LOG:
Total depth 292 ft. Depth of completed well 292' ft.
Formation: Describe by color, character, size of material, and structure

From ft.	To ft.	Formation
0	6	Sandy soil
6	8	Hardpan
8	22	Brown clay
22	36	Sand
36	49	Gray clay
49	54	Brown sand
54	72	Red sandy clay
72	76	Sand and cobbles
76	82	Red clay and gravel
82	94	Sand and cobbles
94	102	Packed sand
102	106	Red sandy clay
106	119	Packed sand
119	132	Sand
132	151	Red clay
151	154	Red sand
154	168	Hard red clay
168	174	Sandy clay
174	180	Fine sand
180	212	Soft red clay
212	217	Medium brown sand
217	230	Red clay
230	234	Sandy clay
234	246	Red clay
246	261	Brown sandy clay
261	285	Red clay
285	292	Fine white sand

Work started 12/13/65, Completed 12/17/65

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME: Bill Belknap
(Person, firm, or corporation) (Typed or printed)
Address: 9274 So. Buttonwillow Ave.
Reedley, California 93654
[SIGNED] vh
(Well Driller)
License No. 106833 Dated 9/6/66 19__

SKETCH LOCATION OF WELL ON REVERSE SIDE

APPENDIX F

CASTLE AFB SUPPLEMENTAL INFORMATION

F.1 - Pesticides On-Hand at Castle AFB
F.2 - Fuel Storage Tanks

TABLE F.1

PESTICIDES ON-HAND AT CASTLE AIR FORCE BASE

(Compiled from Entomology Shop Inventory - July 1983)

Phenothrin Aerosol	Bealate
Ficam-W	R-55 Repellent
Diazinon E	Final
Rozol G	Rodenticide
Avitrol	Chlordane
Diazinon D	Rodent Bait
Pyrenone	Spike
Sevin	Hyvar
Baygon	Round-Up
Rocide	

TABLE F.2
FUEL STORAGE TANKS

Facility Number	Capacity BBL	Capacity GAL	Type AG/UG	Roof	Current Status	Current Product	Type Tank	Cathodic Protection	Remarks
Or9111-1	596	25000	UG		Active	JP-4	Hroz	Yes	
9111-2	596	25000	UG		Active	JP-4	Horz	Yes	
9111-3	596	25000	UG		Active	JP-4	Horz	Yes	
9111-4	596	25000	UG		Active	JP-4	Horz	Yes	
9111-5	596	25000	UG		Active	JP-4	Horz	Yes	
9111-6	596	25000	UG		Active	JP-4	Horz	Yes	
9111-7	596	25000	UG		Active	JP-4	Horz	Yes	
9111-8	596	25000	UG		Active	JP-4	Horz	Yes	
9111-9	596	25000	UG		Active	JP-4	Horz	Yes	
9111-10	477	20000	UG		Active	JP-4	Horz	Yes	
9112-1	1191	50000	UG		Active	JP-4	Horz	Yes	
9112-2	1191	50000	UG		Active	JP-4	Horz	Yes	
9112-3	1191	50000	UG		Active	JP-4	Horz	Yes	
	1191	50000	UG		Active	JP-4	Horz	Yes	
9113-5	1191	50000	UG		Active	JP-4	Horz	Yes	
9113	SAME AS FACILITY 9111								
9117-1	1191	50000	UG		Active	JP-4	Horz	Yes	
9117-2	1191	50000	UG		Active	JP-4	Horz	Yes	
9117-3	1191	50000	UG		Active	JP-4	Horz	Yes	
9117-4	1191	50000	UG		Active	JP-4	Horz	Yes	
9117-5	1191	50000	UG		Active	JP-4	Horz	Yes	
9117-6	1191	50000	UG		Active	JP-4	Horz	Yes	
1216-1	1191	50000	UG		Active	JP-4	Horz	Yes	
1216-2	1191	50000	UG		Active	JP-4	Horz	Yes	
1216-3	1191	50000	UG		Active	JP-4	Horz	Yes	

UG - Underground
AG - Above Ground

TABLE F.2
(Continued)
FUEL STORAGE TANKS

Facility Number	Capacity BBL	Capacity GAL	Type AG/UG	Roof	Current Status	Current Product	Type Tank	Cathodic Protection	Remarks
1216-4	1191	50000	UG		Active	JP-4	Horz	Yes	
1216-5	1191	50000	UG		Active	JP-4	Horz	Yes	
1216-6	1191	50000	UG		Active	JP-4	Horz	Yes	
72	32700	1373400	AG	Floating	Active	JP-4	Vert	Yes	
73	11900	499800	AG	Floating	Active	JP-4	Vert	Yes	
76	15500	65100	AG	Floating Pan	Active	JP-4	Vert	Yes	Cone Roof
83	15000	630000	AG	Floating	Active	JP-4	Vert	Yes	
4112	10000	420000	AG	Cone	Active	JP-7	Vert	Yes	
4114	10000	420000	AG	Cone	Active	JP-7	Vert	Yes	
4204-1	239	10000	UG		Active	MoGas	Horz	No	Bldg. 1325
4204-2	239	10000	UG		Active	MoGas	Horz	No	Bldg. 1325
4204-3	119	5000	UG		Active	JP-4	Horz	No	Bldg. 1325
4161-1	239	10000	UG		Contaminated Fuel				Behind 65
4161-2	119	5000	UG		Contaminated Fuel				Behind 65
4161-3	119	5000	UG		Contaminated Fuel				Behind 65
4165-1	95	4000	UG		Active	MoGas	Horz	No	Bldg. 65
4165-2	191	8000	UG		Active	MoGas	Horz	No	Bldg. 65
4153	286	12000	UG		Active	MoGas	Horz	No	Bldg. 502
4154	286	12000	UG		Active	MoGas	Horz	No	Bldg. 502
4155	286	12000	UG		Active	MoGas	Horz	No	Bldg. 502
4152	286	12000	UG		Active	MoGas	Horz	No	Bldg. 502
4156	24	1000	UG		Inactive		Horz	No	
1553	119	5000	UG		Active	MoGas	Horz	No	84th AGE

UG - Underground
AG - Above Ground

TABLE F.2
(Continued)
FUEL STORAGE TANKS

Facility Number	Capacity BBL	GAL	Type AG/UG	Roof	Current Status	Current Product	Type Tank	Cathodic Protection	Remarks
505	286	12000	AG		Active	Diesel	Horz	No	POL Area
1313-1	119	5000	AG		Active	Cont.	Horz	No	Burn Pit
1313-2	119	5000	AG		Active	Fuel	Horz	No	Area

AG - Above Ground

APPENDIX G

USAF INSTALLATION RESTORATION PROGRAM
HAZARD ASSESSMENT RATING METHODOLOGY

APPENDIX G

USAF INSTALLATION RESTORATION PROGRAM
HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

The Department of Defense (DOD) has established a comprehensive program to identify, evaluate, and control problems associated with past disposal practices at DOD facilities. One of the actions required under this program is to:

> "develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts." (Reference: DEQPPM 81-5, 11 December 1981).

Accordingly, the United States Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the Records Search phase of its Installation Restoration Program (IRP).

The first site rating model was developed in June 1981 at a meeting with representatives from USAF Occupational Environmental Health Laboratory (OEHL), Air Force Engineering Services Center (AFESC), Engineering-Science (ES) and CH_2M Hill. The basis for this model was a system developed for EPA by JRB Associates of McLean, Virginia. The JRB model was modified to meet Air Force needs.

After using this model for 6 months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF OEHL, AFESC, various major commands, Engineering Science, and CH_2M Hill met to address the inadequacies. The result of the meeting was a new site rating model designed to present a better picture of the hazards posed by sites at Air Force installations. The new rating model described in this presentation is referred to as the Hazard Assessment Rating Methodology.

PURPOSE

The purpose of the site rating model is to provide a relative ranking of sites of suspected contamination from hazardous substances. This model will assist the Air Force in setting priorities for follow-on site investigations and confirmation work under Phase II of IRP.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazardous wastes present in sufficient quantity), and (2) potential for migration exists. A site can be deleted from consideration for rating on either basis.

DESCRIPTION OF MODEL

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DOD program needs.

The model uses data readily obtained during the Record Search portion (Phase I) of the IRP. Scoring judgments and computations are easily made. In assessing the hazards at a given site, the model develops a score based on the most li' y routes of contamination and the worst hazards at the site. Sites are given low scores only if there are clearly no hazards at the site. This approach meshes well with the policy for evaluating and setting restrictions on excess DOD properties.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination, the waste and its characteristics, potential pathways for waste contaminant migration, and any efforts to contain the contaminants. Each of these categories contains a number of rating factors that are used in the overall hazard rating.

The receptors category rating is calculated by scoring each factor, multiplying by a factor weighting constant and adding the weighted scores to obtain a total category score.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned and for direct evidence 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. These routes are surface water migration, flooding, and ground-water migration. Evaluation of each route involves factors associated with the particular migration route. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The scores for each of the three categories are then added together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Sites at which there is no containment are not reduced in score. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category factor to the sum of the scores for the other three categories.

FIGURE 1

HAZARD ASSESSMENT RATING METHODOLOGY FLOW CHART

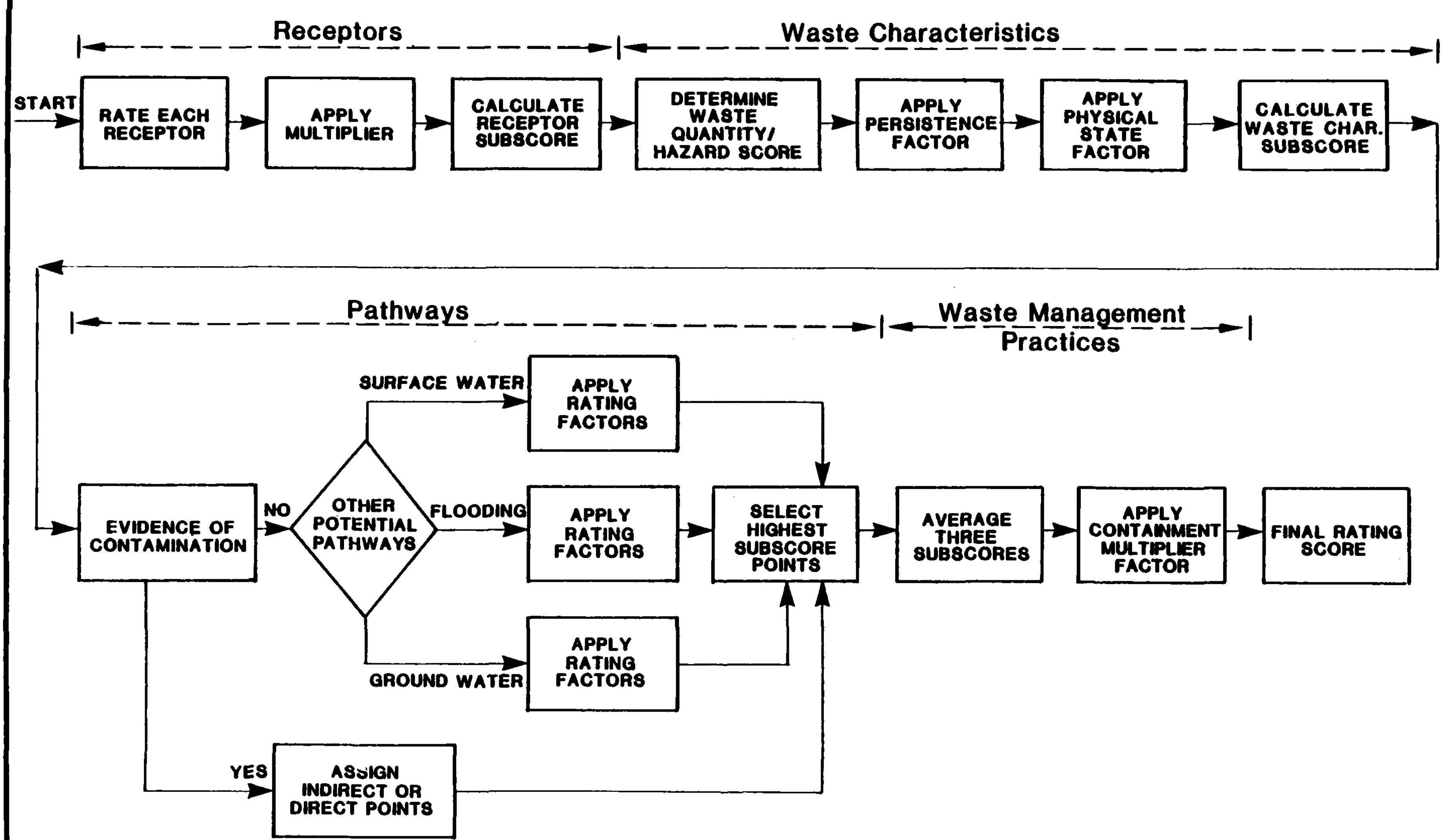

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE ______________________________

LOCATION ______________________________

DATE OF OPERATION OR OCCURRENCE ______________________________

OWNER/OPERATOR ______________________________

COMMENTS/DESCRIPTION ______________________________

SITE RATED BY ______________________________

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site		4		
B. Distance to nearest well		10		
C. Land use/zoning within 1 mile radius		3		
D. Distance to reservation boundary		6		
E. Critical environments within 1 mile radius of site		10		
F. Water quality of nearest surface water body		6		
G. Ground water use of uppermost aquifer		9		
H. Population served by surface water supply within 3 miles downstream of site		6		
I. Population served by ground-water supply within 3 miles of site		6		
		Subtotals	______	______

Receptors subscore (100 X factor score subtotal/maximum score subtotal) ______

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) ______
2. Confidence level (C = confirmed, S = suspected) ______
3. Hazard rating (H = high, M = medium, L = low) ______

Factor Subscore A (from 20 to 100 based on factor score matrix) ______

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

______ X ______ = ______

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

______ X ______ = ______

FIGURE 2 (Continued)

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		

Subtotals ______ ______

Subscore (100 X factor score subtotal/maximum score subtotal) ______

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding		1		

Subscore (100 x factor score/3) ______

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		

Subtotals ______ ______

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors ______
Waste Char -teristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

______ X ______ = ☐

TABLE 1

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1 - 25	26 - 100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land Use/Zoning (within 1 mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1 mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination.	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands.	10
F. Water quality/use designation of nearest surface water body	Agricultural or industrial use.	Recreation, propagation and management of fish and wildlife.	Shellfish propagation and harvesting.	Potable water supplies	6
G. Ground-Water use of uppermost aquifer	Not used, other sources readily available.	Commercial, industrial, or irrigation, very limited other water sources.	Drinking water, municipal water available.	Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available.	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1 - 50	51 - 1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1 - 50	51 - 1,000	Greater than 1, 000	6

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS

A-1 *Hazardous Waste Quantity*

S = Small quantity (<5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (>20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- o Verbal reports from interviewer (at least 2) or written information from the records.
- o Knowledge of types and quantities of wastes generated by shops and other areas on base.
- o Based on the above, a determination of the types and quantities of waste disposed of at the site.

S = Suspected confidence level

- o No verbal reports or conflicting verbal reports and no written information from the records.
- o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site.

A-3 Hazard Rating

Hazard Category	Rating Scale Levels 0	1	2	3
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2	Sax's Level 3
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS (Continued)

Waste Characteristics Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
80	L	C	M
	M	C	H
70	L	S	H
60	S	C	H
	M	C	M
50	L	S	M
	L	C	L
	M	S	H
	S	C	M
40	S	S	H
	M	S	M
	M	C	L
	L	S	L
30	S	C	L
	M	S	L
	S	S	M
20	S	S	L

Notes:
For a site with more than one hazardous waste, the waste quantities may be added using the following rules:
Confidence Level
- o Confirmed confidence levels (C) can be added
- o Suspected confidence levels (S) can be added
- o Confirmed confidence levels cannot be added with suspected confidence levels

Waste Hazard Rating
- o Wastes with the same hazard rating can be added
- o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Persistence Criteria	Multiply Point Rating From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical State	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

Rating Factor	Rating Scale Levels: 0	1	2	3	Multiplier
B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION					
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 in.	-10 to + 5 in.	+5 to +20 in.	Greater than +20 in.	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1 year 24-hr rainfall	<1.0 inch	1.0-2.0 inches	2.1-3.0 inches	>3.0 inches	8
B-2 POTENTIAL FOR FLOODING					
Floodplain	Beyond 100-year floodplain	In 25-year flood-plain	In 10-year flood-plain	Floods annually	1
B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION					
Depth to ground water	Greater than 500 ft	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 in.	-10 to +5 in.	+5 to +20 in.	Greater than +20 in.	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

IV. **WASTE MANAGEMENT PRACTICES CATEGORY**

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. **WASTE MANAGEMENT PRACTICES FACTOR**

The following multipliers are then applied to the total risk points (from A):

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- o Clay cap or other impermeable cover
- o Leachate collection system
- o Liners in good condition
- o Adequate monitoring wells

Spills:

- o Quick spill cleanup action taken
- o Contaminated soil removed
- o Soil and/or water samples confirm total cleanup of the spill

Surface Impoundments:

- o Liners in good condition
- o Sound dikes and adequate freeboard
- o Adequate monitoring wells

Fire Proection Training Areas:

- o Concrete surface and berms
- o Oil/water separator for pretreatment of runoff
- o Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1 or III-B-3, then leave blank for calculation of factor score and maximum possible score.

APPENDIX H

HAZARD ASSESSMENT RATING METHODOLOGY FORMS

APPENDIX H

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HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Landfill No.1, Chemical Disposal Pit Nos. 1,2 and 3
Location: Castle AFB - Southeast of Base Gym
Date of Operation or Occurrence: 1940 - 1950
Owner/Operator: Castle AFB
Comments/Description: Pits recieved cadmium, cyanide, drums of chemicals

Site Rated by: C. Mangan

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			133	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 74

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 2
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

80 x 1.00 = 80

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

80 x 1.00 = 80

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	3	6	18	18
Surface erosion	2	8	16	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			72	108
Subscore (100 x factor score subtotal/maximum score subtotal)				67
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	3	6	18	18
Soil permeability	2	8	16	24
Subsurface flows	3	8	24	24
Direct access to ground water	3	8	24	24
Subtotals			106	114
Subscore (100 x factor score subtotal/maximum score subtotal)				93

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 93

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		74
Waste Characteristics		80
Pathways		93
Total	247 divided by 3 =	82 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

82 x 1.20 = 82

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Landfill No. 5, Chemical Disposal Pit Nos. 7, 8, and 9
Location: Castle AFB - Northeast of Compass Rose
Date of Operation or Occurrence: 1971 -1977
Owner/Operator: Castle AFB
Comments/Description: Pits received bulk quantities of oil, solvents, paint stripper

Site Rated by: C. Mangan

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			119	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 66

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 3
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 1.00 = 100

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

100 x 1.00 = 100

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	2	8	16	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			54	108
Subscore (100 x factor score subtotal/maximum score subtotal)				50
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	3	8	24	24
Subtotals			72	114
Subscore (100 x factor score subtotal/maximum score subtotal)				63

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 63

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		66
Waste Characteristics		100
Pathways		63
Total	229	divided by 3 = 76 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

76 x 1.00 = 76

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Fire Protection Training Area No. 1
Location: Castle AFB - East of dog kennels - Bldg 1710
Date of Operation or Occurrnce: 1955 - 1975
Owner/Operator: Castle AFB
Comments/Description: Contained unlined chemical pit containing flammable chemicals

Site Rated by: C. Mangan

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			130	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 72

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 3
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 1.00 = 100

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

100 x 1.00 = 100

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
Subtotals			64	114
Subscore (100 x factor score subtotal/maximum score subtotal)				56

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		72	
Waste Characteristics		100	
Pathways		56	
Total	228	divided by 3 =	76 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

76 x 1.00 = 76

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Discharge Area No. 1 (DA-1)
Location: Facility 953 - Jet Engine Test Cell
Date of Operation or Occurrence: 1950's to 1983
Owner/Operator: Castle AFB
Comments/Description: Waste solvents and fuels were allowed to runoff into adjacent surface soils

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			130	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 72

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 3
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 2

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

80 x 0.90 = 72

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

72 x 1.00 = 72

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	2	8	16	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			46	108
Subscore (100 x factor score subtotal/maximum score subtotal)				43
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	0	0	0
Direct access to ground water	3	8	24	24
Subtotals			64	90
Subscore (100 x factor score subtotal/maximum score subtotal)				71

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 71

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		72	
Waste Characteristics		72	
Pathways		71	
Total	215 divided by 3 =		72 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

72 x 1.00 = \ 72 \

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Discharge Area No.8 (DA-8)
Location: Castle AFB - Drainage Ditch South of Building 1550
Date of Operation or Occurrence: Pre 1973 - 1977
Owner/Operator: Castle AFB
Comments/Description: Spent trichloroethylene was disposed of in the ditch

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			131	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 73

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.00 = 60

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.00 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
Subtotals			64	114
Subscore (100 x factor score subtotal/maximum score subtotal)				56

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		73
Waste Characteristics		60
Pathways		80
Total	213 divided by 3 =	71 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

71 x 1.00 = \ 71 \

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Fuel Spill No. 1 (FS-1)
Location: Pumphouse No. 3 - Building 1403
Date of Operation or Occurrence: Nov. 1977
Owner/Operator: Castle AFB
Comments/Description: 21,000 gallon JP-4 spill, 1000 gallons recovered

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			117	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 65

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 3
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 0.80 = 80

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

80 x 1.00 = 80

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			22	108
Subscore (100 x factor score subtotal/maximum score subtotal)				20
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	0	0	0
Direct access to ground water	3	8	24	24
Subtotals			64	90
Subscore (100 x factor score subtotal/maximum score subtotal)				71

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 71

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	65	
Waste Characteristics	80	
Pathways	71	
Total 216 divided by 3 =		72 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

72 x 0.95 = 68

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Discharge Area No. 7 (DA-7)
Location: Behind Entomology Building 908
Date of Operation or Occurrence: Prior to 1979
Owner/Operator: Castle AFB
Comments/Description: Discharged rinse water from cleaning pesticide application equipment

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			137	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 76

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.00 = 60

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.00 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			30	108
Subscore (100 x factor score subtotal/maximum score subtotal)				28
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	3	8	24	24
Subtotals			72	114
Subscore (100 x factor score subtotal/maximum score subtotal)				63

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 63

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		76
Waste Characteristics		60
Pathways		63
Total	199 divided by 3 =	66 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

66 x 1.00 = 66

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Landfill No. 4, Chemical Disposal Pit Nos. 5 and 6
Location: Castle AFB - Northwest of taxiway No. 2
Date of Operation or Occurrence: 1957 - 1970
Owner/Operator: Castle AFB
Comments/Description: Pits received bulk quantities of oil and solvents

Site Rated by: C. Mangan

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			119	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 66

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 3
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

70 x 1.00 = 70

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

70 x 1.00 = 70

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	3	8	24	24
Subtotals			72	114
Subscore (100 x factor score subtotal/maximum score subtotal)				63

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 63

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		66	
Waste Characteristics		70	
Pathways		63	
Total	199 divided by 3 =		66 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

66 x 1.00 = 66

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Discharge Area No. 4 (DA-4)
Location: Building 1316 - Liquid Oxygen Plant
Date of Operation or Occurrence: 1950 - 1980
Owner/Operator: Castle AFB
Comments/Description: TCE used to clean filters was discharged to adjucent ground surface

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			123	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 68

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.00 = 60

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.00 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			30	108
Subscore (100 x factor score subtotal/maximum score subtotal)				28
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	0	0	0
Direct access to ground water	3	8	24	24
Subtotals			64	90
Subscore (100 x factor score subtotal/maximum score subtotal)				71

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 71

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		68	
Waste Characteristics		60	
Pathways		71	
Total	199	divided by 3 =	66 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

66 x 1.00 = 66

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Discharge Area No. 2 (DA-2)
Location: Hardstand No. 5 - Non-powered AGE washrack
Date of Operation or Occurrence: 1970's to 1983
Owner/Operator: Castle AFB
Comments/Description: Received cleaning solvents, oils, and soaps

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			121	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 67

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 2
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 2

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 0.90 = 54

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

54 x 1.00 = 54

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ?

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			30	108
Subscore (100 x factor score subtotal/maximum score subtotal)				28
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	0	0	0
Direct access to ground water	3	8	24	24
Subtotals			64	90
Subscore (100 x factor score subtotal/maximum score subtotal)				71

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 71

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		67	
Waste Characteristics		54	
Pathways		71	
Total	192 divided by 3 =		64 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

64 x 1.00 = 64

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Discharge Area No. 3 (DA-3)
Location: Building 850 - CE Washrack
Date of Operation or Occurrence: 1950 - 1983
Owner/Operator: Castle AFB
Comments/Description: Received runoff from washrack

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			137	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 76

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 2

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

50 x 0.90 = 45

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

45 x 1.00 = 45

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi- plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			46	108
Subscore (100 x factor score subtotal/maximum score subtotal)				43
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	0	0	0
Direct access to ground water	3	8	24	24
Subtotals			64	90
Subscore (100 x factor score subtotal/maximum score subtotal)				71

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 71

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		76	
Waste Characteristics		45	
Pathways		71	
Total	192 divided by 3 =		64 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

64 x 1.00 = 64

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Fuel Spill No. 4 (FS-4)
Location: Beneath Taxiway No. 9
Date of Operation or Occurrence: Early 1960's
Owner/Operator: Castle AFB
Comments/Description: Hydrant System Pipe Rupture

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			117	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 65

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 2
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

80 x 0.80 = 64

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

64 x 1.00 = 64

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			22	108
Subscore (100 x factor score subtotal/maximum score subtotal)				20
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	3	8	24	24
Subtotals			72	114
Subscore (100 x factor score subtotal/maximum score subtotal)				63

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 63

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		65	
Waste Characteristics		64	
Pathways		63	
Total	192 divided by 3 =		64 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

64 x 1.00 = \ 64 \

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Discharge Area No. 5 (DA-5)
Location: OMS Washrack along flightline
Date of Operation or Occurrence: 1950's - 1982
Owner/Operator: Castle AFB
Comments/Description: Cleaning agents were discharged into adjacent drainage ditchs

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			135	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 75

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 2

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

50 x 0.90 = 45

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

45 x 1.00 = 45

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	0	0	0
Direct access to ground water	3	8	24	24
Subtotals			64	90
Subscore (100 x factor score subtotal/maximum score subtotal)				71

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 71

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	75
Waste Characteristics	45
Pathways	71
Total 191 divided by 3 =	64 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

64 x 1.00 = 64

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Chemical Disposal Pit No.4
Location: Castle AFB - South jet engine test cell - Bldg. 950
Date of Operation or Occurrence: 1950's
Owner/Operator: Castle AFB
Comments/Description: Pit received bulk chemicals - oils, solvents, stripper

Site Rated by: C. Mangan

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			120	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 67

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 3
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

70 x 1.00 = 70

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

70 x 1.00 = 70

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
Subtotals			64	114
Subscore (100 x factor score subtotal/maximum score subtotal)				56

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		67	
Waste Characteristics		70	
Pathways		56	
Total	193	divided by 3 =	64 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

64 x 1.00 = 64

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: PCB Spill Nos. 1,2, and 3
Location: Facility 1203 - Civil Engineering Salvage Yard
Date of Operation or Occurrence: 1980 -1983
Owner/Operator: Castle AFB
Comments/Description: Work order issued to clean up site, not determined whether cleanup occurred

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			133	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 74

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 40

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

40 x 1.00 = 40

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

40 x 1.00 = 40

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			22	108
Subscore (100 x factor score subtotal/maximum score subtotal)				20
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	0	0	0
Direct access to ground water	3	8	24	24
Subtotals			64	90
Subscore (100 x factor score subtotal/maximum score subtotal)				71

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 71

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	74	
Waste Characteristics	40	
Pathways	71	
Total 185 divided by 3 =		62 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

62 x 1.00 = \ 62 \

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Fuel Spill Nos. 2 and 3 (FS-2, FS-3)
Location: Fuel Pumphouses No. 2 and No. 3, Building 1401 and 1412
Date of Operation or Occurrence: 1950's to 1977
Owner/Operator: Castle AFB
Comments/Description: Fuels spills occured periodically as a result of operational practices

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			117	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 65

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 2
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

50 x 0.80 = 40

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

40 x 1.00 = 40

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			22	108
Subscore (100 x factor score subtotal/maximum score subtotal)				20
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	0	0	0
Direct access to ground water	3	8	24	24
Subtotals			64	90
Subscore (100 x factor score subtotal/maximum score subtotal)				71

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 71

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		65
Waste Characteristics		40
Pathways		71
Total	176 divided by 3 =	59 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

59 x 1.00 = 59

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Fire Protection Training Area No. 3
Location: Castle AFB - North of Bldg 1312
Date of Operation or Occurrence: 1976 - present
Owner/Operator: Castle AFB
Comments/Description: Contaminated and uncontaminated fuels used for training

Site Rated by: C. Mangan

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			120	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 67

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 2

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

50 x 0.80 = 40

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

40 x 1.00 = 40

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
Subtotals			64	114
Subscore (100 x factor score subtotal/maximum score subtotal)				56

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		67
Waste Characteristics		40
Pathways		56
Total	163 divided by 3 =	54 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

54 x 1.00 = 54

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Landfill No. 2
Location: Castle AFB - east of jet engine test cell - Bldg. 350
Date of Operation or Occurrence: 1951 -1953
Owner/Operator: Castle AFB
Comments/Description: Landfill received refuse and small quantities of chemicals

Site Rated by: C. Mangan

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			126	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 70

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 1

Factor Subscore A (from 20 to 100 based on factor score matrix) 20

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

20 x 0.80 = 16

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

16 x 1.00 = 16

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	3	8	24	24
Subtotals			72	114
Subscore (100 x factor score subtotal/maximum score subtotal)				63

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 63

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		70	
Waste Characteristics		16	
Pathways		63	
Total	149 divided by 3 =		50 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

50 x 1.00 = 50

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Discharge Area No. 6 (DA-6)
Location: Adjacent to fuel storage area
Date of Operation or Occurrence: 1960's - 1977
Owner/Operator: Castle AFB
Comments/Description: Closed industrial waste evaporation plant

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			89	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				49

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 2

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

50 x 0.90 = 45

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

45 x 1.00 = 45

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			30	108
Subscore (100 x factor score subtotal/maximum score subtotal)				28
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	3	8	24	24
Subtotals			72	114
Subscore (100 x factor score subtotal/maximum score subtotal)				63

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 63

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		49	
Waste Characteristics		45	
Pathways		63	
Total	157	divided by 3 =	52 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

52 x 0.95 = 50

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Fire Protection Training Area No. 2
Location: Castle AFB - East Taxiway No. 11
Date of Operation or Occurrence: 1962 - 1967
Owner/Operator: Castle AFB
Comments/Description: Used intermittently for fire training for civilian firemen

Site Rated by: C. Mangan

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			120	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 67

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 2

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

50 x 0.80 = 40

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

40 x 1.00 = 40

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
Subtotals			48	114
Subscore (100 x factor score subtotal/maximum score subtotal)				42

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 42

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	67	
Waste Characteristics	40	
Pathways	42	
Total 149 divided by 3 =		50 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

50 x 1.00 = \ 50 \

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Landfill No.3
Location: Castle AFB - North of pistol range
Date of Operation or Occurrence: 1954 - 1956
Owner/Operator: Castle AFB
Comments/Description: Landfill recieved refuse and small quantities of chemicals

Site Rated by: C. Mangan

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			119	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 66

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 1

Factor Subscore A (from 20 to 100 based on factor score matrix) 20

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

20 x 0.80 = 16

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

16 x 1.00 = 16

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore - 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	2	8	16	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			54	108
Subscore (100 x factor score subtotal/maximum score subtotal)				50
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	3	8	24	24
Subtotals			72	114
Subscore (100 x factor score subtotal/maximum score subtotal)				63

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 63

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	66		
Waste Characteristics	16		
Pathways	63		
Total	145 divided by 3 =	48	Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

48 x 1.00 = 48

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: PCB Spill No. 6
Location: Building 851
Date of Operation or Occurrence: 1982
Owner/Operator: Castle AFB
Comments/Description: 1 - 15 gallons of PCB spilled, cleaned-up

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			137	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 76

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.00 = 60

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.00 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	0	0	0
Direct access to ground water	3	8	24	24
Subtotals			64	90
Subscore (100 x factor score subtotal/maximum score subtotal)				71

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 71

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		76
Waste Characteristics		60
Pathways		71
Total	207 divided by 3 =	69 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

69 x 0.10 = 7

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: PCB Spill No. 4
Location: Building No. 534
Date of Operation or Occurrence: 1970 - 1980
Owner/Operator: Castle AFB
Comments/Description: PCB spilled was cleaned-up

Site Rated by: C. Mangan

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			137	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 76

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.00 = 60

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.00 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			30	108
Subscore (100 x factor score subtotal/maximum score subtotal)				28
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	0	0	0
Direct access to ground water	3	8	24	24
Subtotals			64	90
Subscore (100 x factor score subtotal/maximum score subtotal)				71

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 71

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		76	
Waste Characteristics		60	
Pathways		71	
Total	207 divided by 3 =		69 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

69 x 0.10 = 7

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: PCB Spill No. 8
Location: Building 350
Date of Operation or Occurrence: May 1982
Owner/Operator: Castle AFB
Comments/Description: Small spill of contaminated PCB oil (PCB concentration 7ppm), cleaned-up

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			135	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 75

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 40

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

40 x 1.00 = 40

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

40 x 1.00 = 40

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			30	108
Subscore (100 x factor score subtotal/maximum score subtotal)				28
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	0	0	0
Direct access to ground water	3	8	24	24
Subtotals			64	90
Subscore (100 x factor score subtotal/maximum score subtotal)				71

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 71

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	75	
Waste Characteristics	40	
Pathways	71	
Total 186 divided by 3 =		62 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

62 x 0.10 = 6

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: PCB Spill No.5
Location: Building 404
Date of Operation or Occurrence: 1979-1982
Owner/Operator: Castle AFB
Comments/Description: PCB Spill was cleaned-up

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			141	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.00 = 60

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.00 = 60

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			30	108
Subscore (100 x factor score subtotal/maximum score subtotal)				28
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
Subtotals			64	114
Subscore (100 x factor score subtotal/maximum score subtotal)				56

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		78	
Waste Characteristics		60	
Pathways		56	
Total	194 divided by 3 =		65 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

65 x 0.10 = 6

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: PCB Spill No. 7
Location: Building 1800
Date of Operation or Occurrence: 1980
Owner/Operator: Castle AFB
Comments/Description: PCB Spill was cleaned-up

Site Rated by: M. I. Spiegel

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			71	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 39

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 40

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

40 x 1.00 = 40

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

40 x 1.00 = 40

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
Subtotals			64	114
Subscore (100 x factor score subtotal/maximum score subtotal)				56

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	39	
Waste Characteristics	40	
Pathways	56	
Total 135 divided by 3 =		45 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

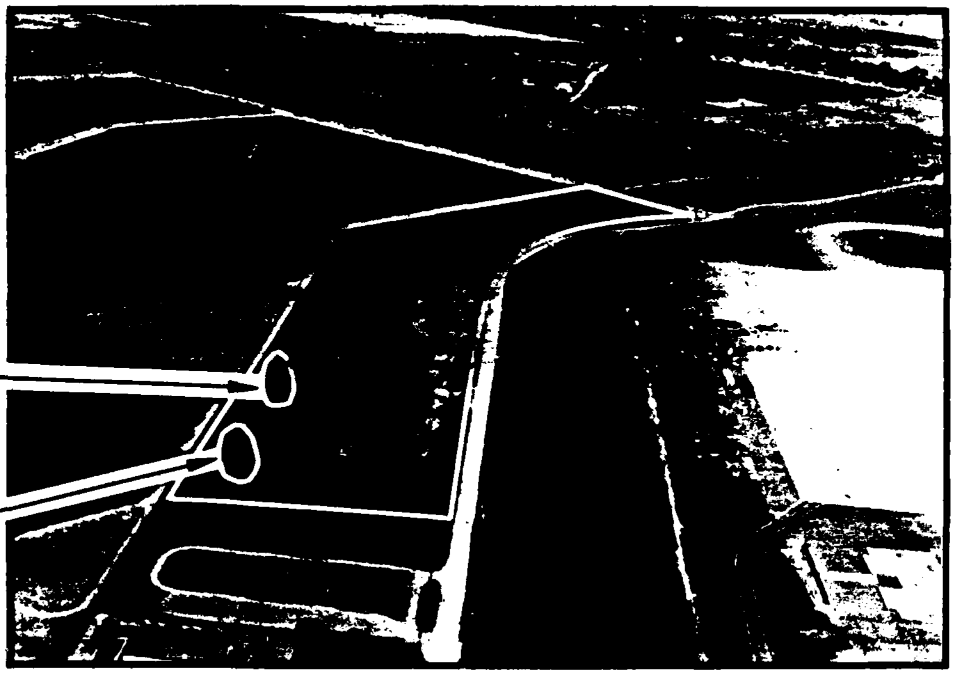
45 x 0.10 = 5

APPENDIX I

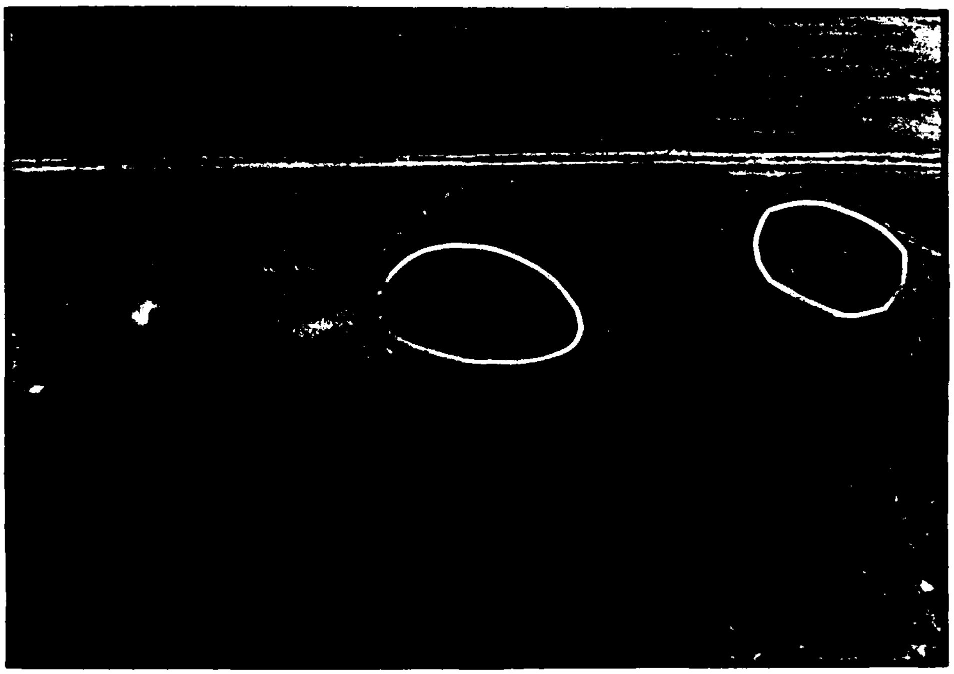
PHOTOGRAPHS

Landfill No. 1 Disposal Pits No. 1, 2, and 3 and Discharge Area No. 6

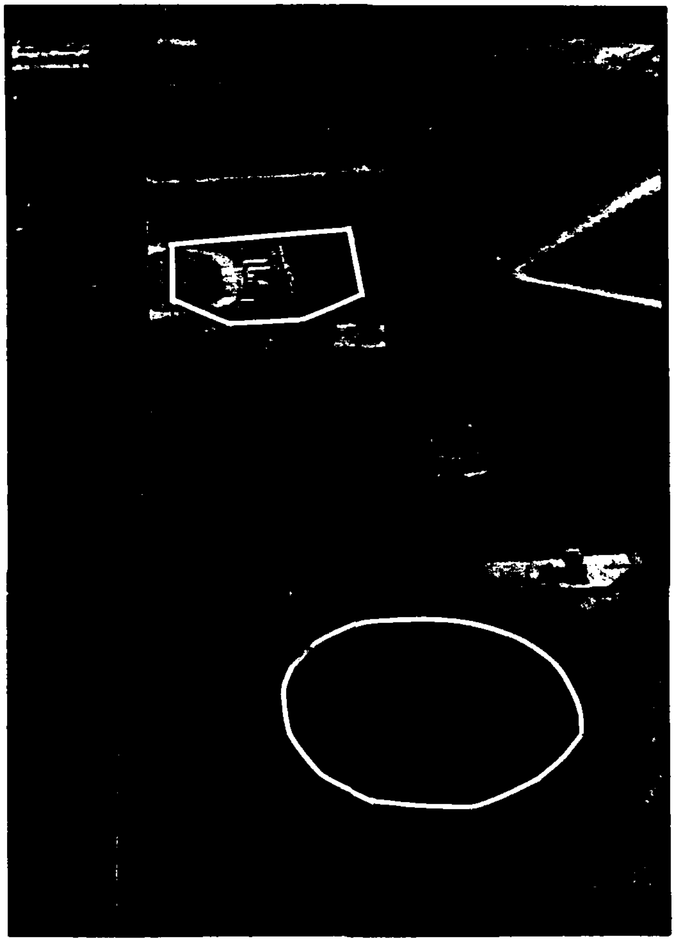
Landfill No. 2 Discharge Area No. 1 and Disposal Pit No. 4



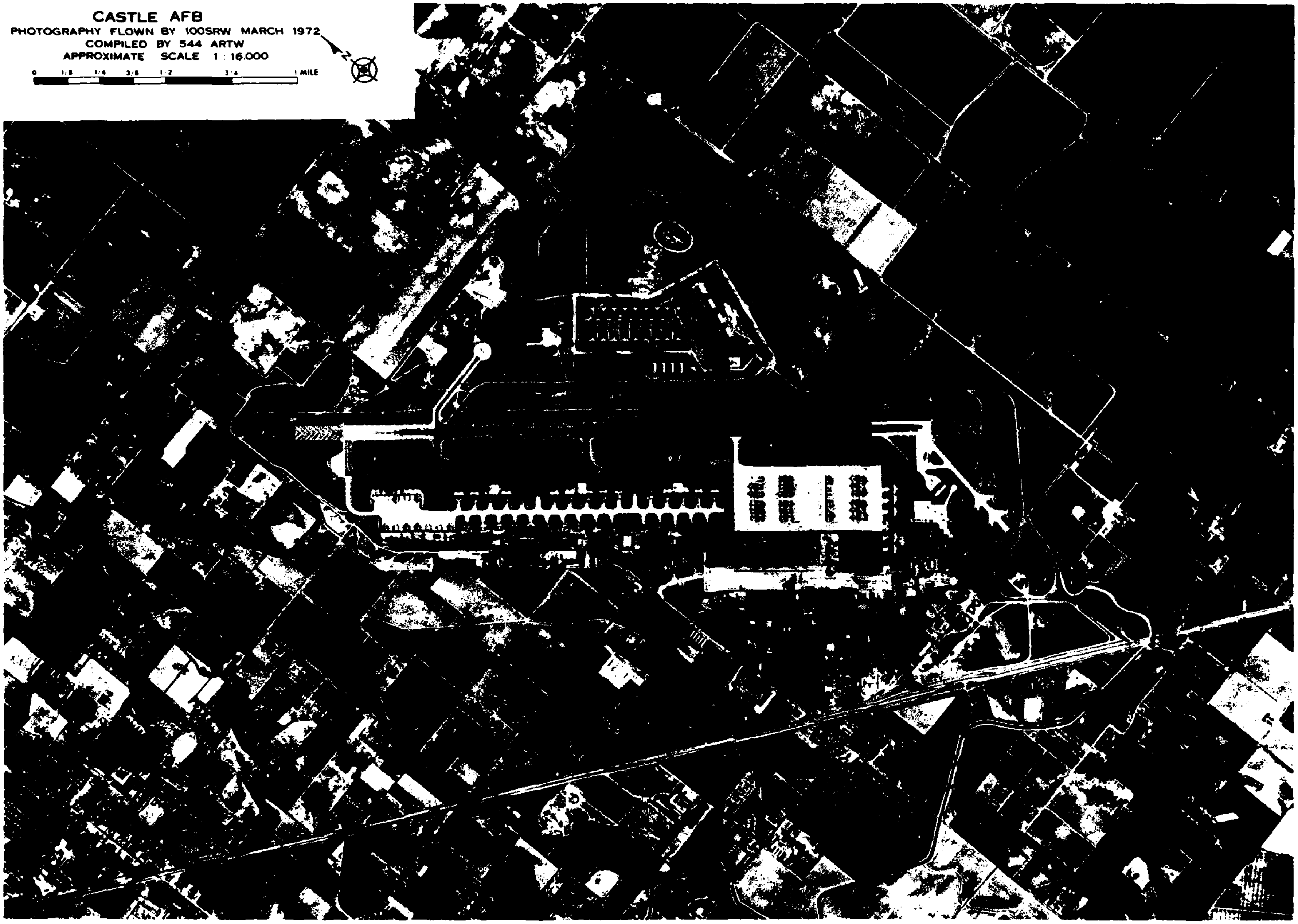
Landfill No. 4
Fire Protection Training Area No. 2
Disposal Pits No. 5 and 6



Fire Protection Training Area No. 1



Fire Protection Training Area No. 3
and Discharge Area No. 4



CASTLE AFB
PHOTOGRAPHY FLOWN BY 100SRW MARCH 1972
COMPILED BY 544 ARTW
APPROXIMATE SCALE 1 : 16,000
0 1/8 1/4 3/8 1/2 3/4 1 MILE

APPENDIX J

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REFERENCES

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APPENDIX K
GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

APPENDIX K
GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

ABG: Air Base Group.

AF: Air Force.

AFB: Air Force Base.

AFESC: Air Force Engineering and Services Center.

AFFF: Aqueous Film Forming Foam, a fire extinquishing agent.

AFR: Air Force Regulation.

AFRES: Air Force Reserve.

AFS: Air Force Station.

Ag: Chemical symbol for silver.

AG: Above Ground

AGE: Aerospace Ground Equipment.

Al: Chemical symbol for aluminum.

AMS: Avionics Maintenance Squadron.

ARTESIAN: Ground water contained under hydrostatic pressure.

AQUICLUDE: Poorly permeable formation that impedes ground-water movement and does not yield to a well or spring.

AQUIFER: A geologic formation, group of formations, or part of a formation that is capable of yielding water to a well or spring.

AQUITARD: A geologic unit which impedes ground-water flow.

ATC: Air Training Command.

AVGAS: Aviation Gasoline.

Ba: Chemical symbol for barium.

BEE: Bioenvironmental Engineering Services.

BIOACCUMULATE: Tendency of elements or compounds to accumulate or build up in the tissues of living organisms when they are exposed to these elements in their environments, e.g., heavy metals.

BOWSER: A portable tank to contain waste fuels, oils and chemicals.

CAFB: Castle Air Force Base.

Cd: Chemical symbol for cadmium.

CE: Civil Engineering.

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act.

CES: Civil Engineering Squadron.

CIRCA: About; used to indicate an approximate date.

CLOSURE: The completion of a set of rigidly defined functions for a hazardous waste facility no longer in operation.

CN: Chemical symbol for cyanide.

COD: Chemical Oxygen Demand, a measure of the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water.

COE: Corps of Engineers.

CONFINED AQUIFER: An aquifer bounded above and below by impermeable strata or by geologic units of distinctly lower permeability than that of the aquifer itself.

CONFINING UNIT: An aquitard or other poorly permeable layer which restricts the movement of ground water.

CONTAMINATED FUEL: Fuel that does not meet specifications that may be recovered or recycled.

CONTAMINATION: The degradation of natural water quality to the extent that its usefulness is impaired; there is no implication of any specific limits since the degree of permissible contamination depends upon the intended end use or uses of the water.

Cr: Chemical symbol for chromium.

CSG: Combat Support Group.

Cu: Chemical symbol for copper.

DET: Detachment.

DIP: The angle at which a stratum is inclined from the horizontal.

DISPOSAL FACILITY: A facility or part of a facility at which hazardous waste is intentionally placed into or on land or water, and at which waste will remain after closure.

DISPOSAL OF HAZARDOUS WASTE: The discharge, deposit, injection, dumping, spilling, or placing of any hazardous waste into or on land or water so that such waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground water.

DOD: Department of Defense.

DOWNGRADIENT: In the direction of decreasing hydraulic static head; the direction in which ground water flows.

DPDO: Defense Property Disposal Office, previously included Redistribution and Marketing (R&M) and Salvage.

DUMP: An uncovered land disposal site where solid and/or liquid wastes are deposited with little or no regard for pollution control or aesthetics; dumps are susceptible to open burning and are exposed to the elements, disease vectors and scavengers.

EFFLUENT: A liquid waste discharge from a manufacturing or treatment process, in its natural state, or partially or completely treated, that discharges into the environment.

EOD: Explosive Ordnance Disposal.

EP: Extraction Procedure, the EPA's standard laboratory procedure for leachate generation.

EPA: U.S. Environmental Protection Agency.

EPHEMERAL AQUIFER: A water-bearing zone typically located near the surface which normally contains water seasonally.

EROSION: The wearing away of land surface by wind, water, or chemical processes.

FAA: Federal Aviation Administration.

FACILITY: Any land and appurtenances thereon and thereto used for the treatment, storage and/or disposal of hazardous wastes.

FAULT: A fracture in rock along which the adjacent rock surfaces are differentially displaced.

Fe: Chemical symbol for iron.

FLOOD PLAIN: The lowland and relatively flat areas adjoining inland and coastal areas of the mainland and off-shore islands, including, at a minimum, areas subject to a one percent or greater chance of flooding in any given year.

FLOW PATH: The direction or movement of ground water as governed principally by the hydraulic gradient.

FMS: Field Maintenance Squadron.

FPTA: Fire Protection Training Area.

GC/MS: Gas chromatograph/mass spectrophotometer, a laboratory procedure for identifying unknown compounds.

GROUND WATER: Water beneath the land surface in the saturated zone that is under atmospheric or artesian pressure.

HARDFILL: Disposal sites receiving construction debris, wood, miscellaneous spoil material.

HARDPAN: A hard impervious layer of soil clay cemented by insoluble materials.

HARM: Hazard Assessment Rating Methodology.

HAZARDOUS WASTE: As defined in RCRA, a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. As defined in the California Health and Safety Codes four major hazard characteristics have been used to identify hazardous wastes: toxicity, flammability, reactivity, and corrosivity. These hazards are largely a consequence of the chemical compositions and properties of wastes. Radioactive wastes are not subject to control under state hazardous waste regulations.

HAZARDOUS WASTE GENERATION: The act or process of producing a hazardous waste.

HEAVY METALS: Metallic elements. including the transition series, which include many elements required for plant and animal nutrition in trace concentrations but which become toxic at higher concentrations.

Hg: Chemical symbol for mercury.

HQ: Headquarters.

HWMF: Hazardous Waste Management Facility.

ILS: Instrument Landing System.

INCOMPATIBLE WASTE: A waste unsuitable for commingling with another waste or material because the commingling might result in generation of extreme heat or pressure, explosion or violent reaction, fire, formation of substances which are shock sensitive, friction sensitive, or otherwise have the potential for reacting violently, formation of toxic dusts, mists, fumes, and gases, volatilization of ignitable or toxic chemicals due to heat generation in such a manner that the likelihood of

contamination of ground water or escape of the substance into the environment is increased, any other reaction which might result in not meeting the air, human health, and environmental standards.

INFILTRATION: The movement of water through the soil surface into the ground.

IRP: Installation Restoration Program.

JP-4: Jet Propulsion Fuel Number Four.

LEACHATE: A solution resulting from the separation or dissolving of soluble or particulate constituents from solid waste or other man-placed medium by percolation of water.

LEACHING: The process by which soluble materials in the soil, such as nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water.

LENTICULAR: A bed or rock stratum or body that is lens-shaped.

LINER: A continous layer of natural or man-made materials beneath or on the sides of a surface impoundment, landfill, or landfill cell which restricts the downward or lateral escape of hazardous waste, hazardous waste constituents or leachate.

LOX: Liquid Oxygen.

LYSIMETER: A vacuum operated sampling device used for extracting pore water samples at various depths within the unsaturated zone.

MAC: Military Airlift Command.

MAINT: Recording System Maintenance.

MAW: Military Airlift Wing.

MEK: Methyl Ethyl Ketone.

MGD: Million Gallons per Day.

MID: Merced Irrigation District

MMS: Munitions Maintenance Squadron.

MOGAS: Automotive gasoline.

Mn: Chemical symbol for manganese.

MONITORING WELL: A well used to measure ground-water levels and to obtain samples.

MSL: Mean Sea Level.

MUNITION ITEMS: Munitions or portions of munitions having an explosive potential.

MUNITIONS RESIDUE: Non-explosive segments of waste munitions (i.e., bomb casings).

MWR: Morale Welfare and Recreation.

NCO: Non-commissioned Officer.

NCOIC: Non-commissioned Officer In-Charge.

NDI: Non-destructive Inspection.

NET PRECIPITATION: The amount of annual precipitation minus annual evaporation.

NGVD: National Geodetic Vertical Datum of 1929.

Ni: Chemical symbol for nickel.

NPDES: National Pollutant Discharge Elimination System.

OEHL: Occupational and Environmental Health Laboratory.

OIC: Officer-In-Charge.

OMS: Organizational Maintenance Squadron.

ORGANIC: Being, containing or relating to carbon compounds, especially in which hydrogen is attached to carbon.

OSI: Office of Special Investigations.

O&G: Symbols for oil and grease.

Pb: Chemical symbol for lead.

PCB: Polychlorinated Biphenyl; liquids used as a dielectrics in electrical equipment.

PERCOLATION: Movement of moisture by gravity or hydrostatic pressure through interstices of unsaturated rock or soil.

PERMEABILITY: The capacity of a porous rock, soil or sediment for transmitting a fluid without damage to the structure of the medium.

PD-680: Cleaning solvent.

pH: Negative logarithm of hydrogen ion concentration.

PL: Public Law.

PMEL: Precision Measurement Equipment Lab.

POL: Petroleum, Oils and Lubricants.

POLLUTANT: Any introduced gas, liquid or solid that makes a resource unfit for a specific purpose.

POTENTIALLY ACTIVE FAULT: A fault along which movement has occurred within the last 25-million years.

POTENTIOMETRIC SURFACE: The imaginery surface to which water in an artesian aquifer would rise in tightly screened wells penetrating it.

PPB: Parts per billion by weight.

PPM: Parts per million by weight.

PRECIPITATION: Rainfall.

RCRA: Resource Conservation and Recovery Act.

RECHARGE AREA: A surface area in which surface water or precipitation percolates through the unsaturated zone and eventually reaches the zone of saturation. Recharge areas may be natural or manmade.

RECHARGE: The addition of water to the ground-water system by natural or artificial processes.

SAC: Strategic Air Command.

SANITARY LANDFILL: A land disposal site using an engineered method of disposing solid wastes on land in a way that minimizes environmental hazards.

SATURATED ZONE: That part of the earth's crust in which all voids are filled with water.

SCS: U.S. Department of Agriculture Soil Conservation Service.

SEISMICITY: Pertaining to earthquakes or earth vibrations.

SLUDGE: Any garbage, refuse, or slude from a waste treatment plant, water supply treatment, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923).

SOLID WASTE: Any garbage, refuse, or sludge from a waste treatment plant, water supply treatment, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923).

SPILL: Any unplanned release or discharge of a hazardous waste onto or into the air, land, or water.

STORAGE OF HAZARDOUS WASTE: Containment, either on a temporary basis or for a longer period, in such a manner as not to constitute disposal of such hazardous waste.

STP: Sewage Treatment Plant.

TAC: Tactical Air Command.

TCA: 1,1,1,-Tetrachloroethane.

TCE: Trichloroethylene.

TDS: Total Dissolved Solid, a water quality parameter.

TFW: Tactical Fighter Wing.

TOC: Total Organic Carbon.

TOXICITY: The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism.

TRANSMISSIVITY: The rate at which water is transmitted through a unit width of aquifer under a unit hydraulic gradient.

TREATMENT OF HAZARDOUS WASTE: Any method, technique, or process including neutralization designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize the waste or so as to render the waste nonhazardous.

TSD: Treatment, storage or dispo al.

UG: Underground.

UPGRADIENT: In the direction of increasing hydraulic static head; the direction opposite to the prevailing flow of ground-water.

USAF: United States Air Force.

USFWS: United States Fish and Wildlife Service.

USGS: United States Geological Survey.

WATER TABLE: Surface of a body of unconfined ground water at which the pressure is equal to that of the atmosphere.

Zn: Chemical symbol for zinc.

APPENDIX L

INDEX OF REFERENCES TO POTENTIAL CONTAMINATION SOURCES

APPENDIX L

INDEX OF REFERENCES TO POTENTIAL CONTAMINATION SOURCES

Landfill No. 1	pp. 4, 6, 4-25, 4-26, 4-27, 4-28, 4-34, 4-35, 4-36, 4-38, 5-1, 5-2, 5-3, 6-2, 6-3, 6-6, 6-10.
Landfill No. 2	pp. 5, 4-26, 4-27, 4-28, 4-34, 4-35, 5-2, 6-10.
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